3B – Mortality Improvement

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International and National mortality trends

Adrian Gallop

SoA Living to 100 symposium, January 2020

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International mortality trends

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This presentation covers published and unpublished material from a variety of sources and countries. The findings do not necessarily reflect the position of the authors' employers

With thanks to:

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Agenda

Longevity and death rates, country by country

- US and UK are seeing longevity improvements slowing down. Where else?

Analysis: groupings, causes and drivers

- Is this a blip or a trend? Similarities internationally?

What are actuaries, demographers and others doing?

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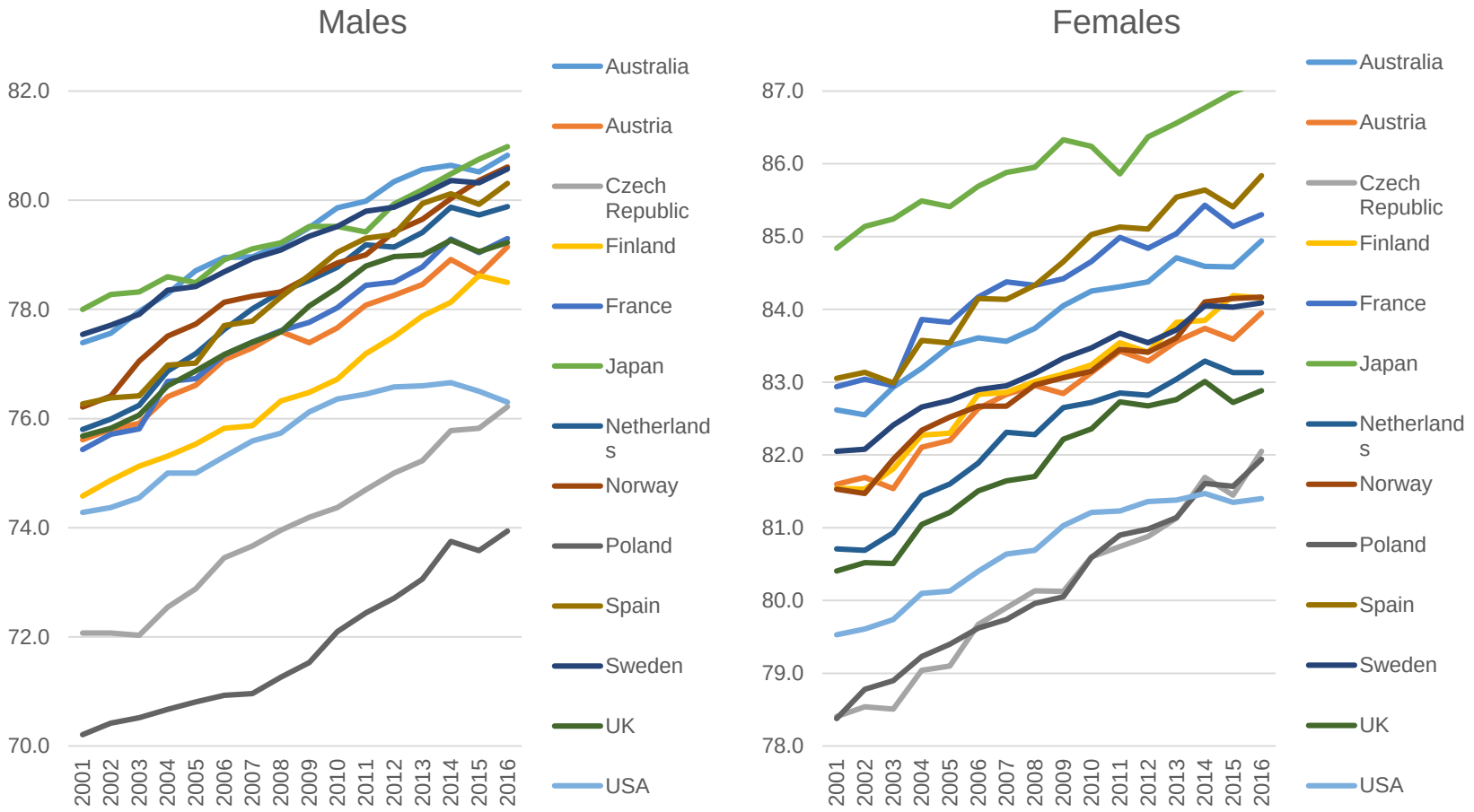
Period life expectancy at birth, 2001 to 2016



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Methodology for comparisons

To compare annual improvement rates against a common base chose to compare the period [2011-most recent year] against a base of [2001-2011].

Method fits trend lines to 2001-11 and 2011 onwards using linear regression.

Selection of high-income countries in Europe and elsewhere considered by population size and availability of recent data

- Comparing rate of increase in longevity:

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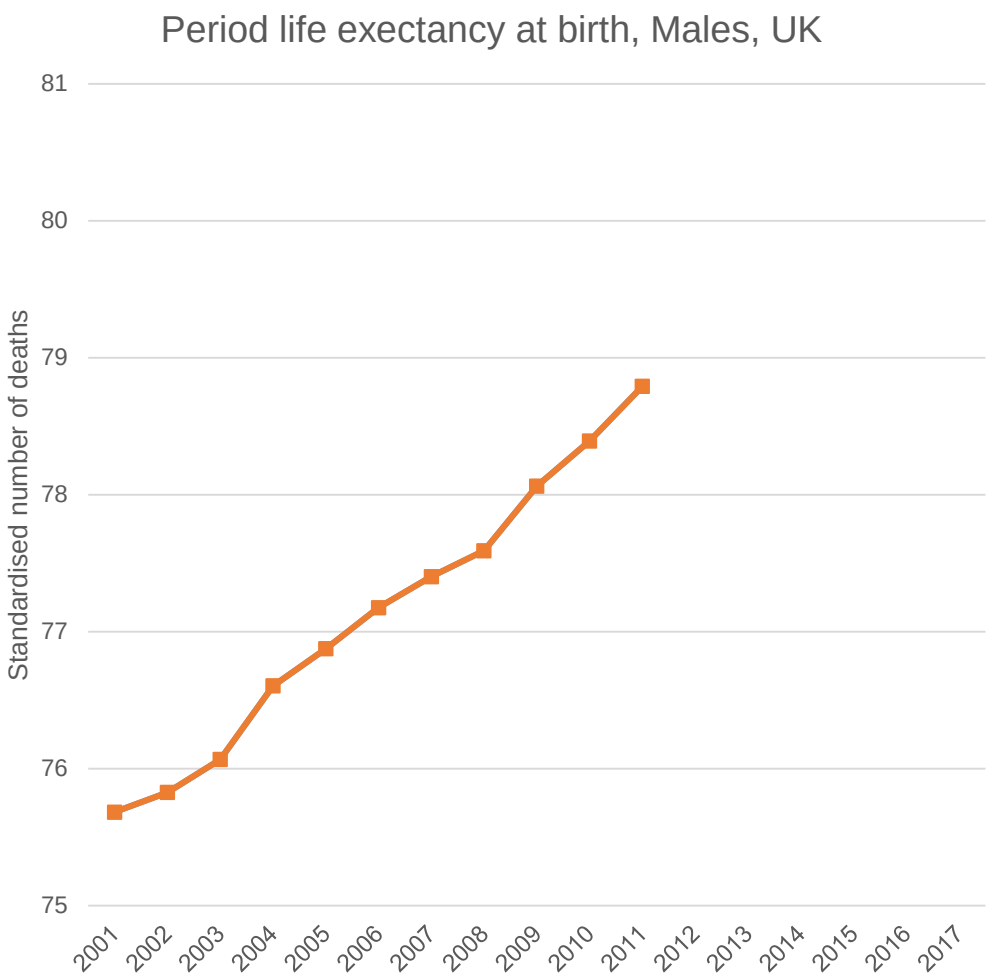
UK: Period life expectancy at birth, Males, Trends



Data 2001-2011

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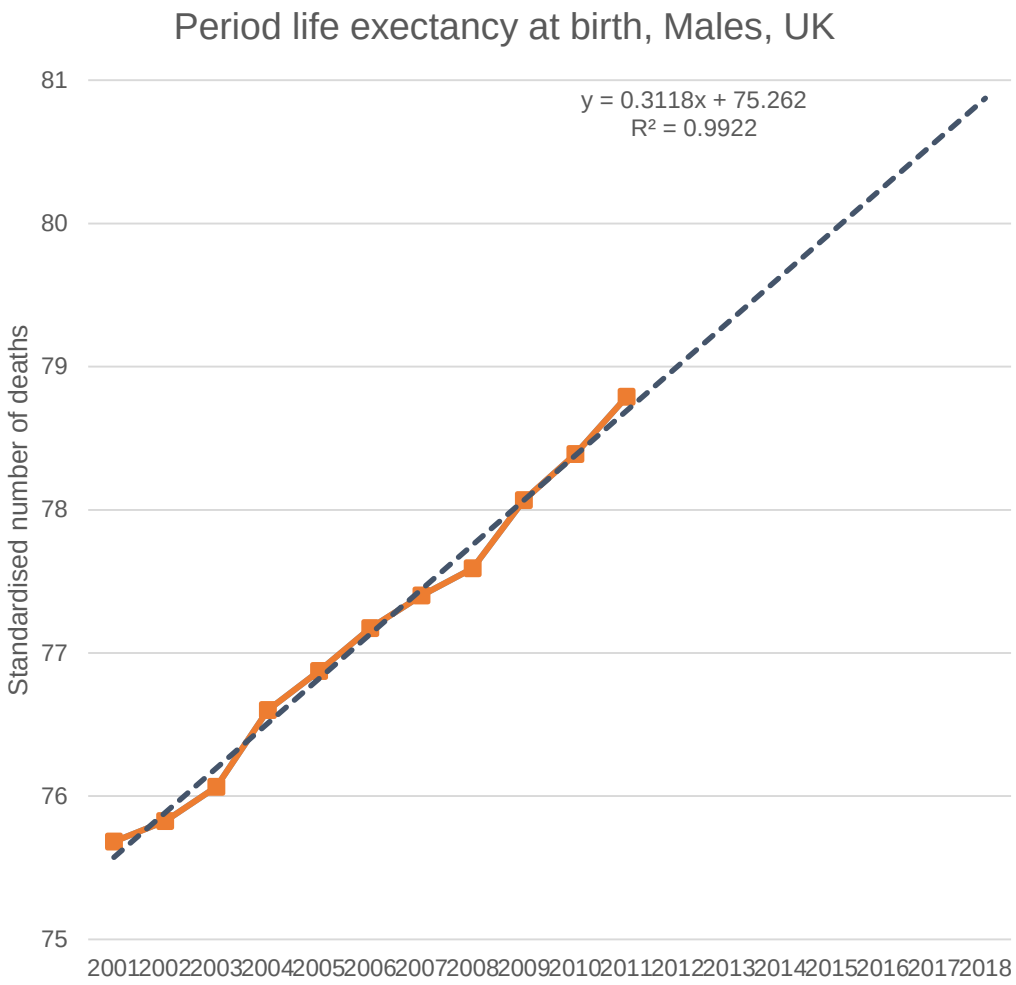
UK: Period life expectancy at birth, Males, Trends



Trend 2001-2011

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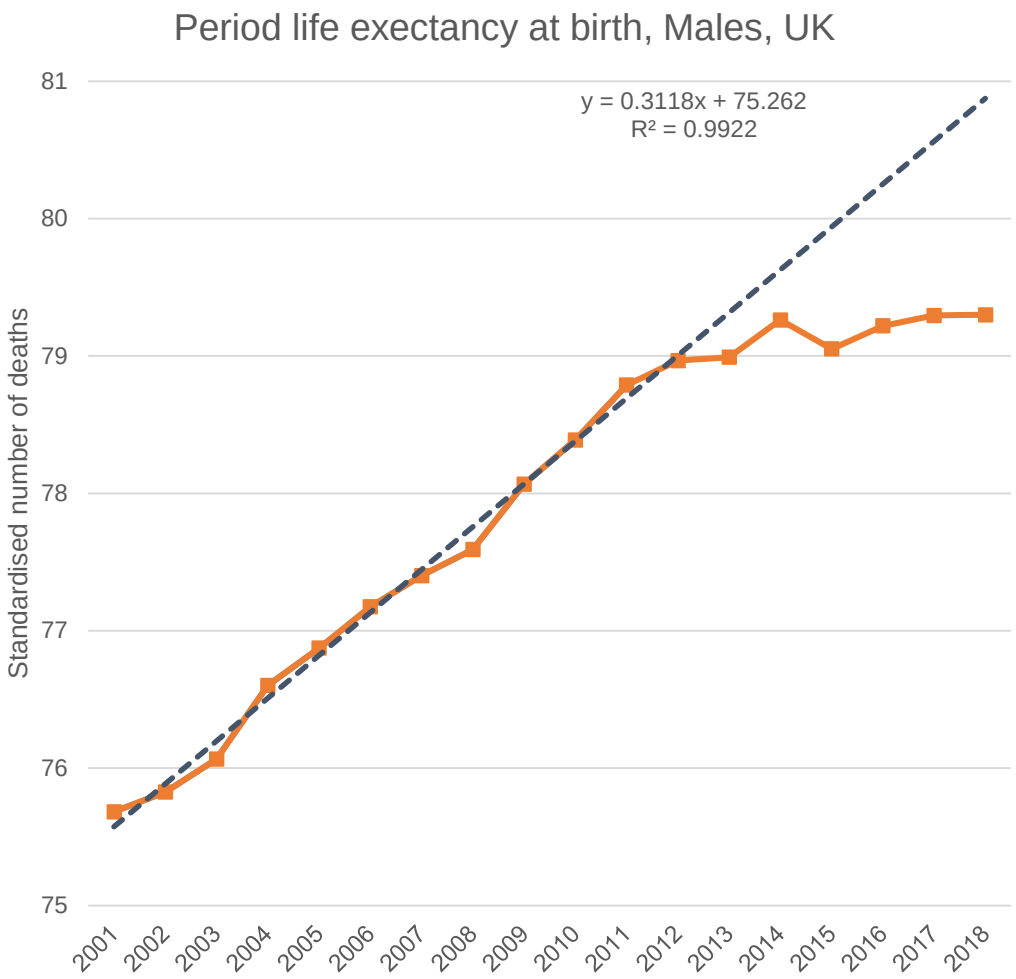
UK: Period life expectancy at birth, Males, Trends



Data to most recent year

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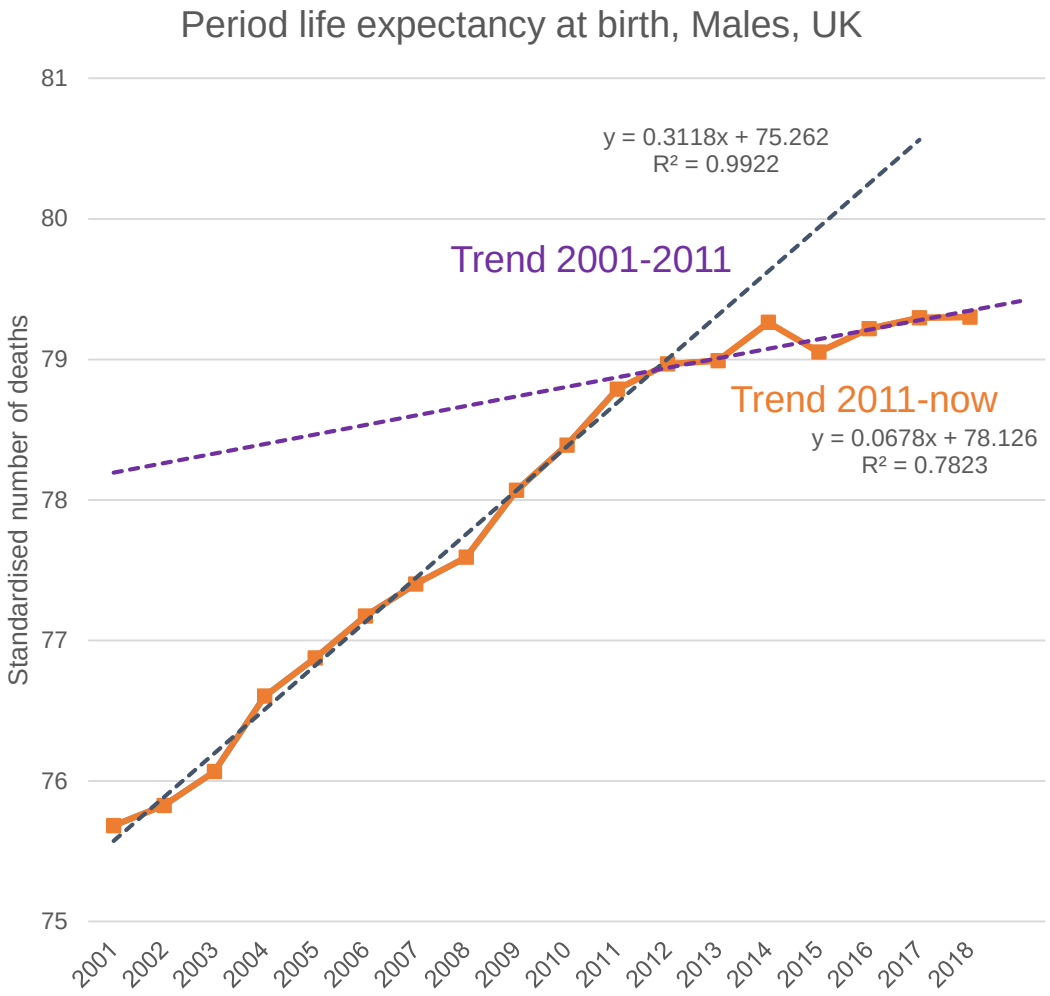
UK: Period life expectancy at birth, Males, Trends



Methodology:

Compare

Trend 2011 to most recent year

against

Trend 2001-2011

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Period life expectancy at birth: Months gained per year elapsed

Average trend annual increase in period life expectancy at birth - Months

Country	Last	Male		Female		Difference	
	Year	2011+	2001-11	2011+	2001-11	M	F
Australia	2016	1.8	3.1	1.3	2.2	-1.3	-0.8
Austria	2017	2.4	3.0	1.2	2.3	-0.6	-1.2
Belgium	2018	2.8	3.4	1.7	2.1	-0.6	-0.4
Canada	2016	1.5	3.0	1.2	2.1	-1.5	-1.0
Czech Rep	2017	2.8	3.6	2.2	3.0	-0.8	-0.8
Denmark	2016	3.0	3.5	2.4	2.9	-0.5	-0.4
Finland	2018	2.9	2.9	1.5	2.5	0.0	-0.9
France	2017	2.1	3.6	0.8	2.5	-1.4	-1.6
Germany	2017	1.4	3.1	0.9	2.0	-1.6	-1.0
Ireland	2017	3.3	4.6	1.8	3.6	-1.4	-1.8
Japan	2017	3.3	1.9	2.7	1.6	1.4	1.1
Netherlands	2017	1.9	4.2	0.9	2.9	-2.4	-2.0
Norway	2018	3.5	3.3	1.9	2.3	0.2	-0.4
Poland	2016	3.4	2.6	2.4	2.6	0.8	-0.2
Spain	2016	2.4	3.8	1.5	2.5	-1.5	-1.0
Sweden	2017	1.9	2.7	1.2	1.9	-0.8	-0.7
Switzerland	2016	2.5	3.5	1.4	2.1	-1.0	-0.8
UK	2016	0.8	3.7	0.4	2.8	-2.9	-2.4
USA	2017	-0.3	2.8	0.3	2.2	-3.1	-2.0

Data source

HMD

NSO

Green = better

Red = worse

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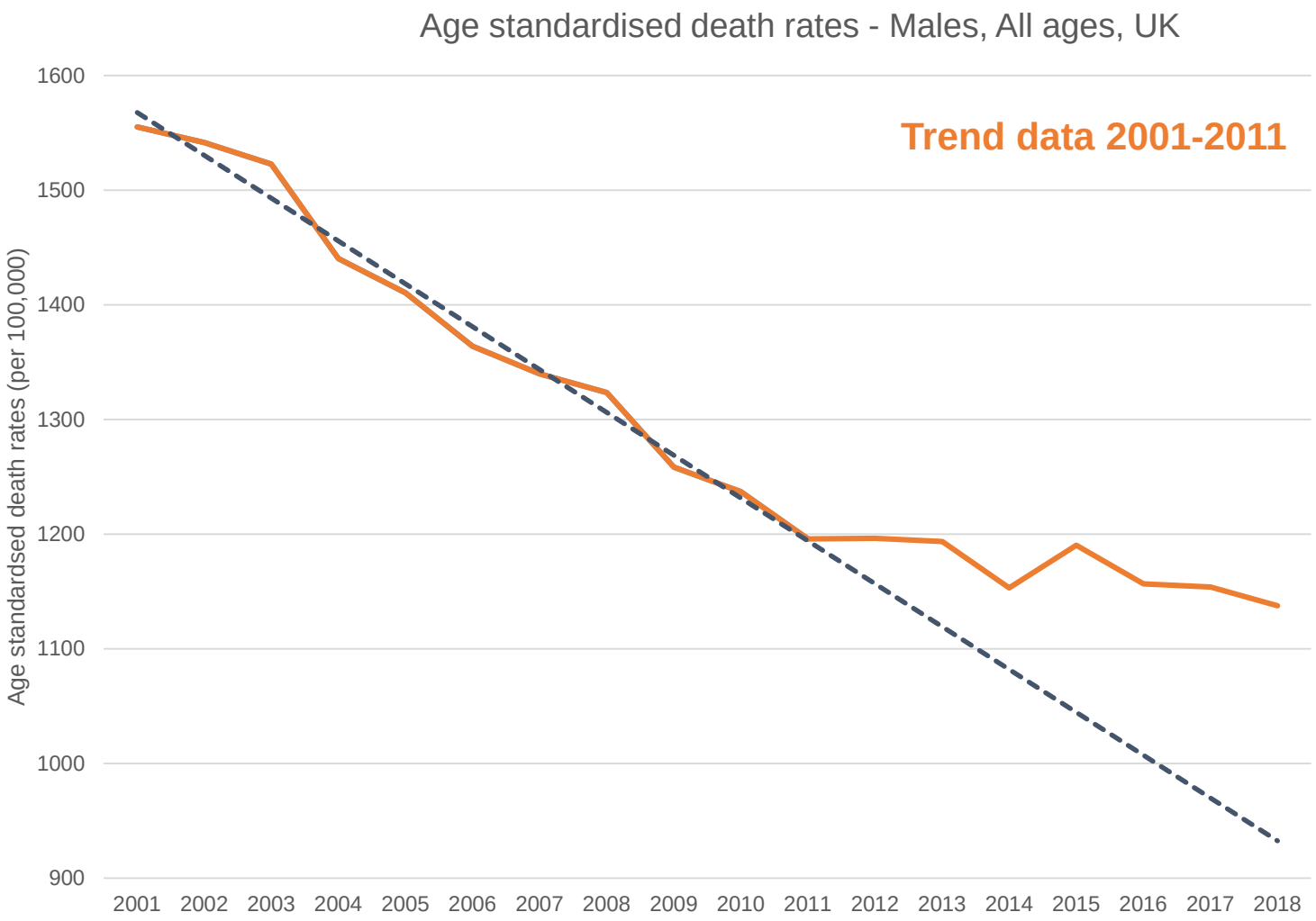
UK: Age standardised death rates, Males



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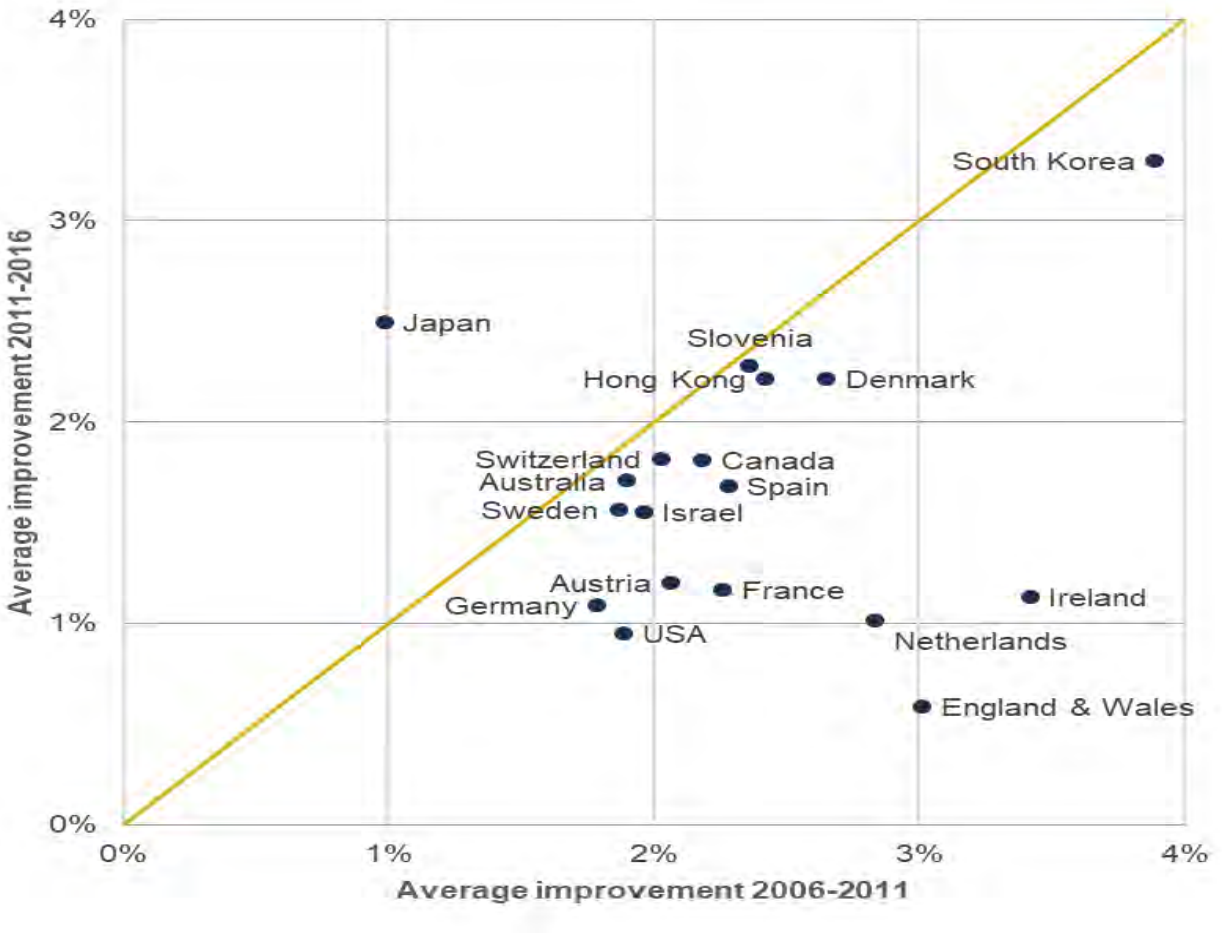
Comparison of average mortality improvements in 2006-11 and 2011-16



Source: CMI Working paper 127

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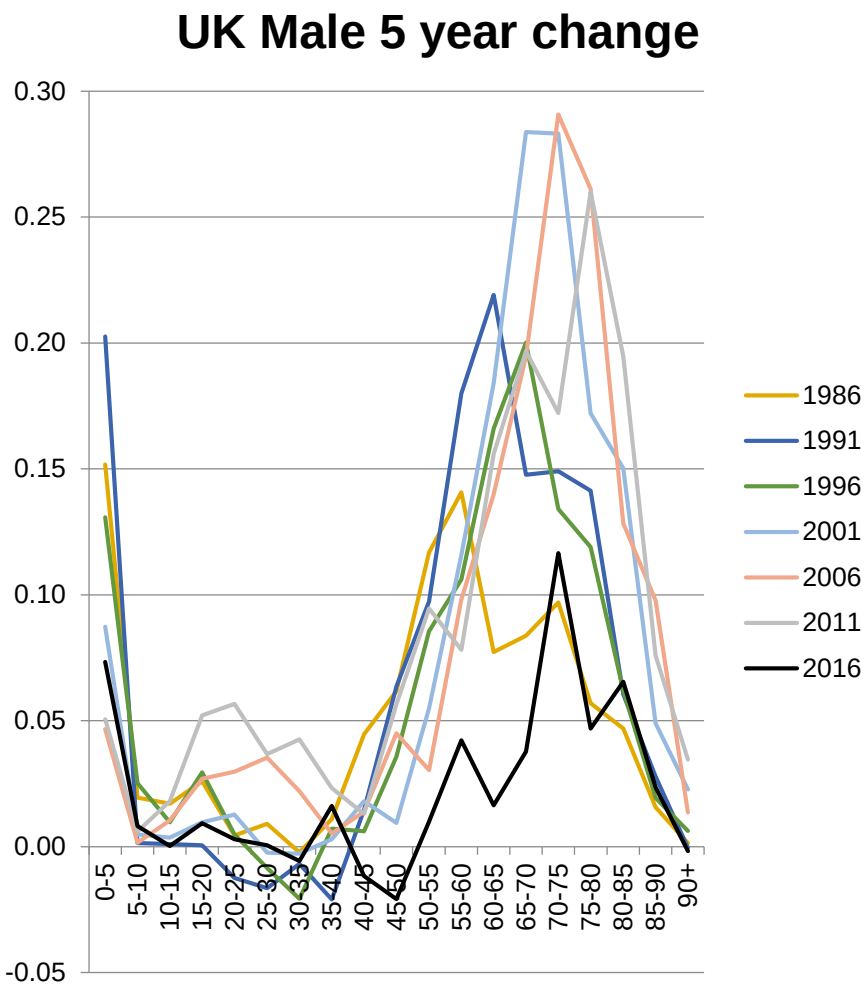
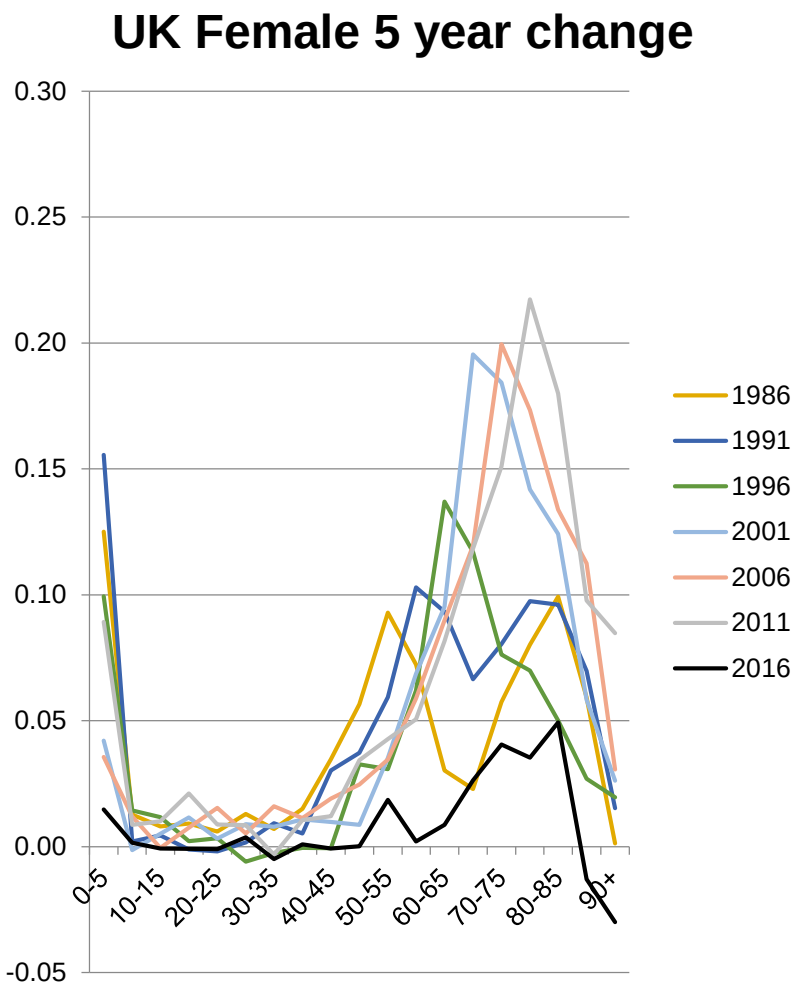
UK: increase in partial life expectancy by 5-year age bands, for 5-year periods ending 1986 to 2016





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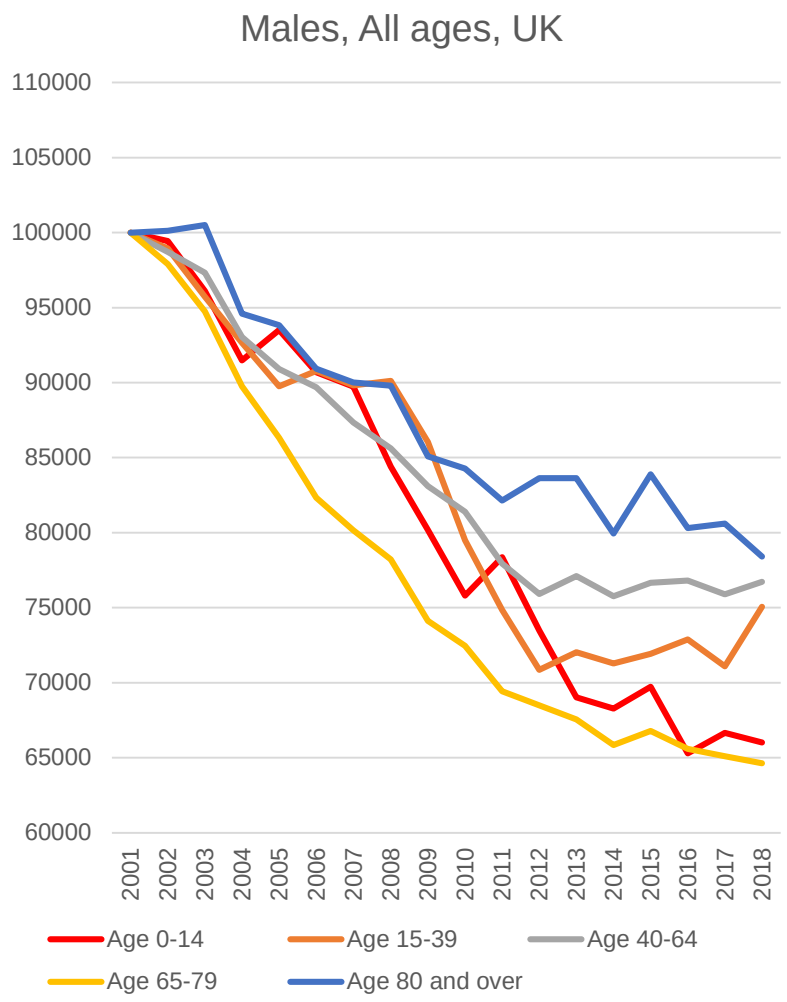
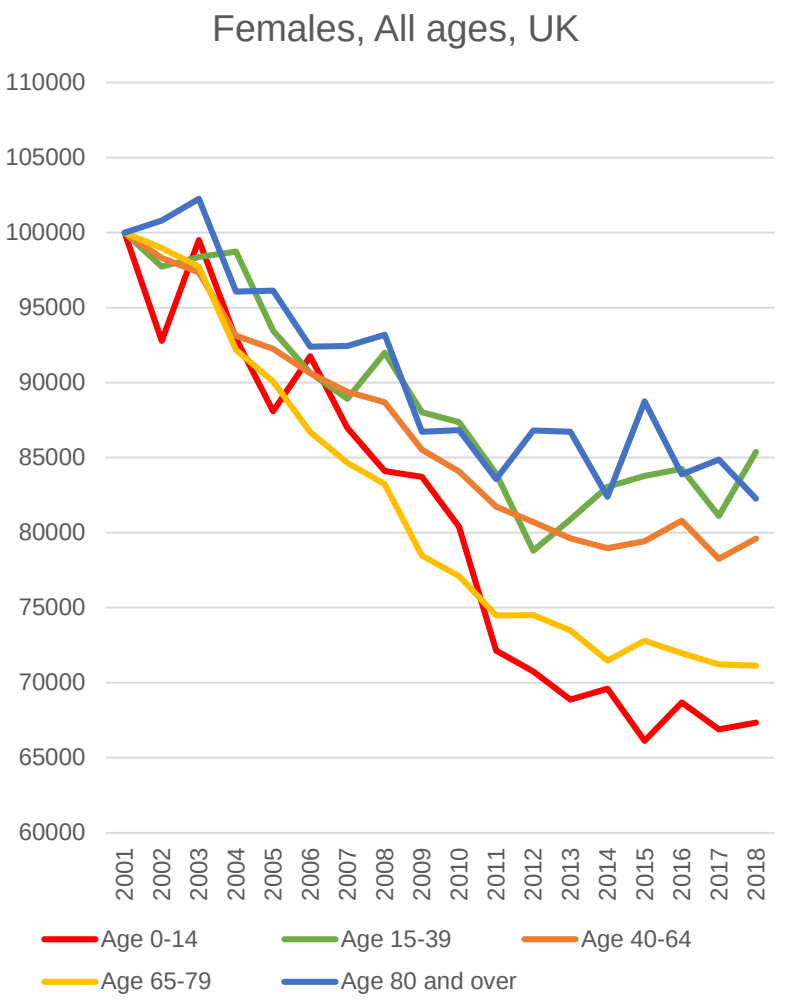
UK: Standardised deaths indexed to 100,000 in 2001





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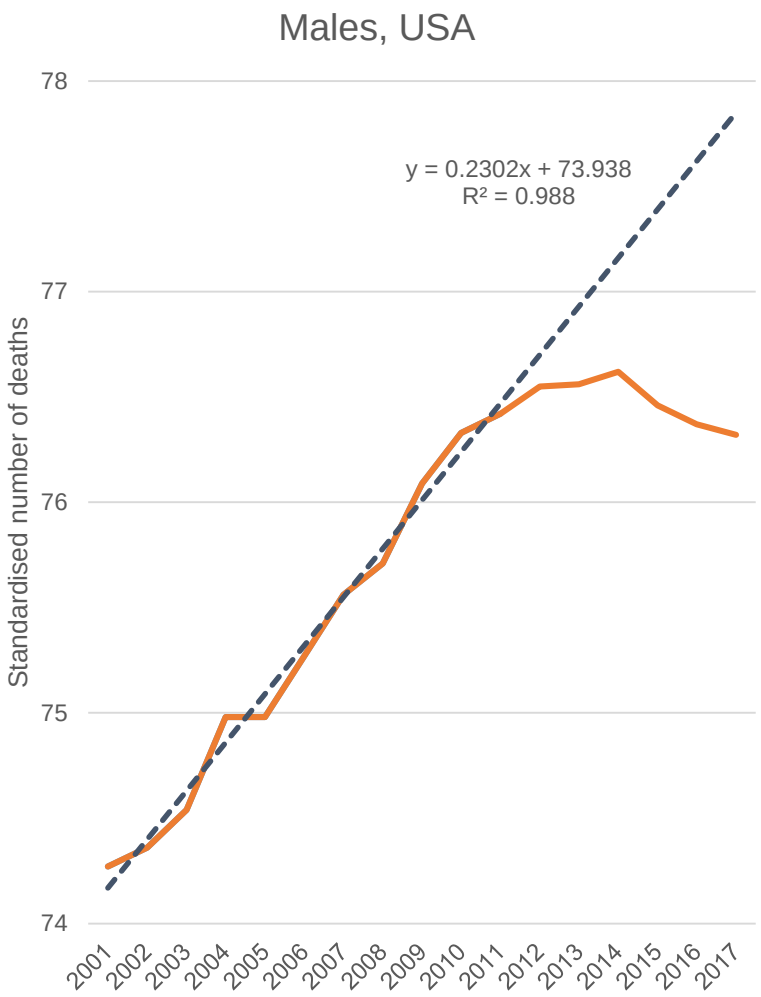
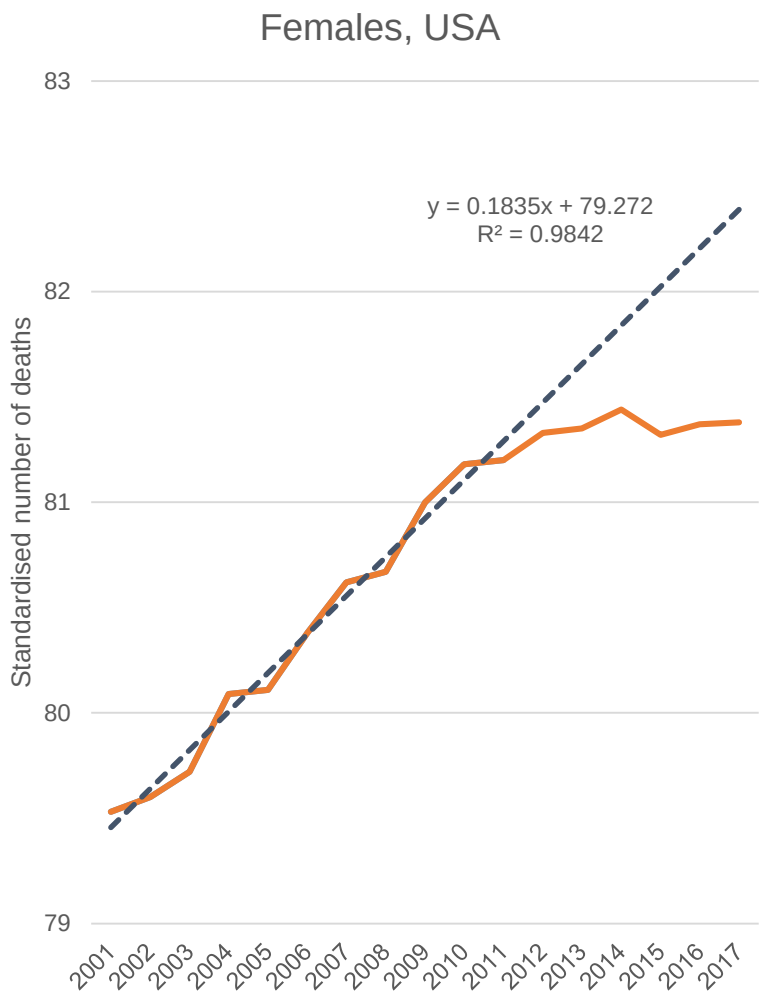
US: Period life expectancy at birth 2001 to 2017





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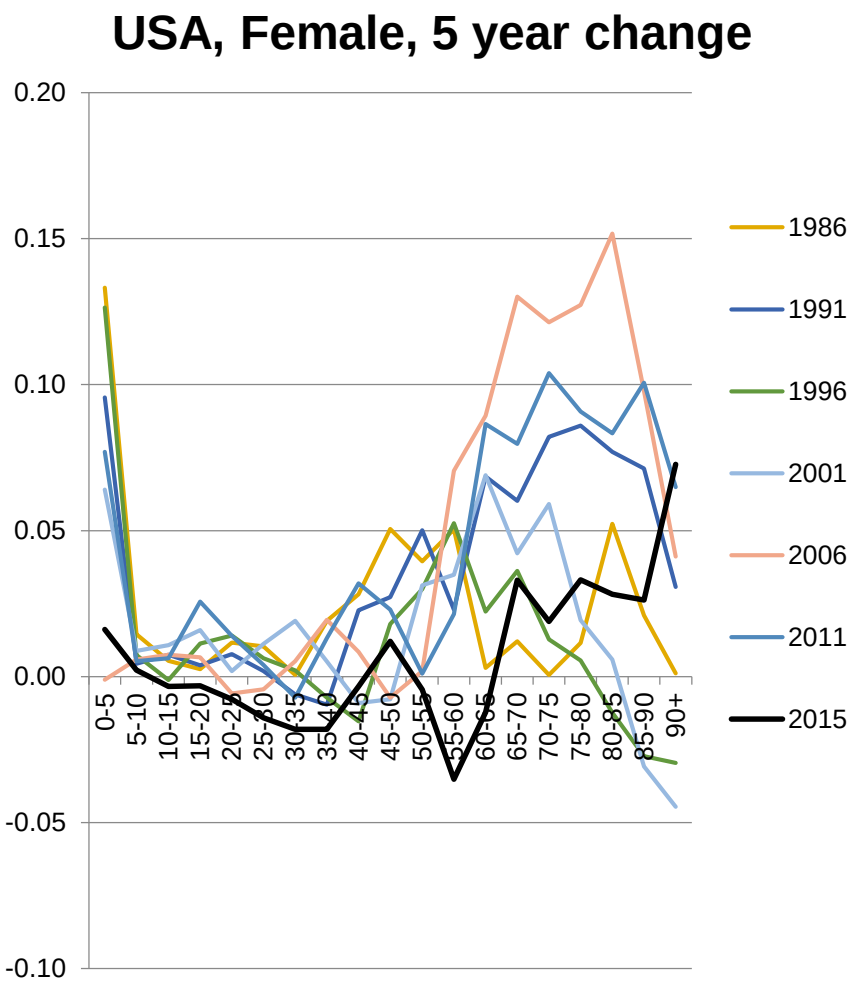
US: increase in partial life expectancy by 5-year age bands, for 5-year periods ending 1986 to 2011 and 4-year to 2015



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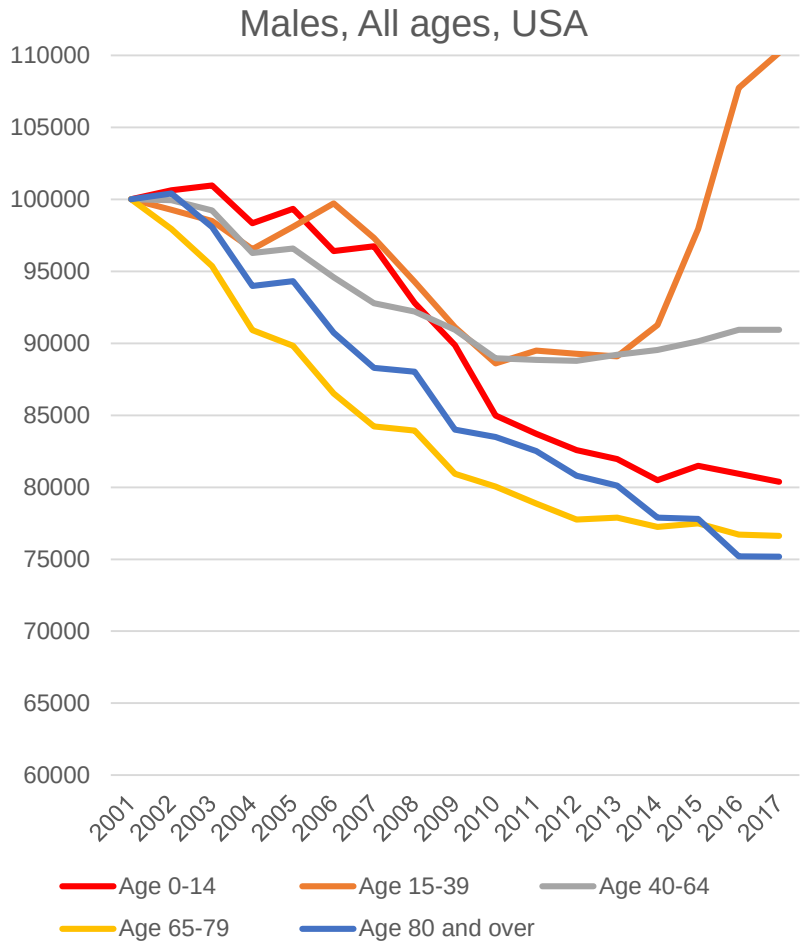
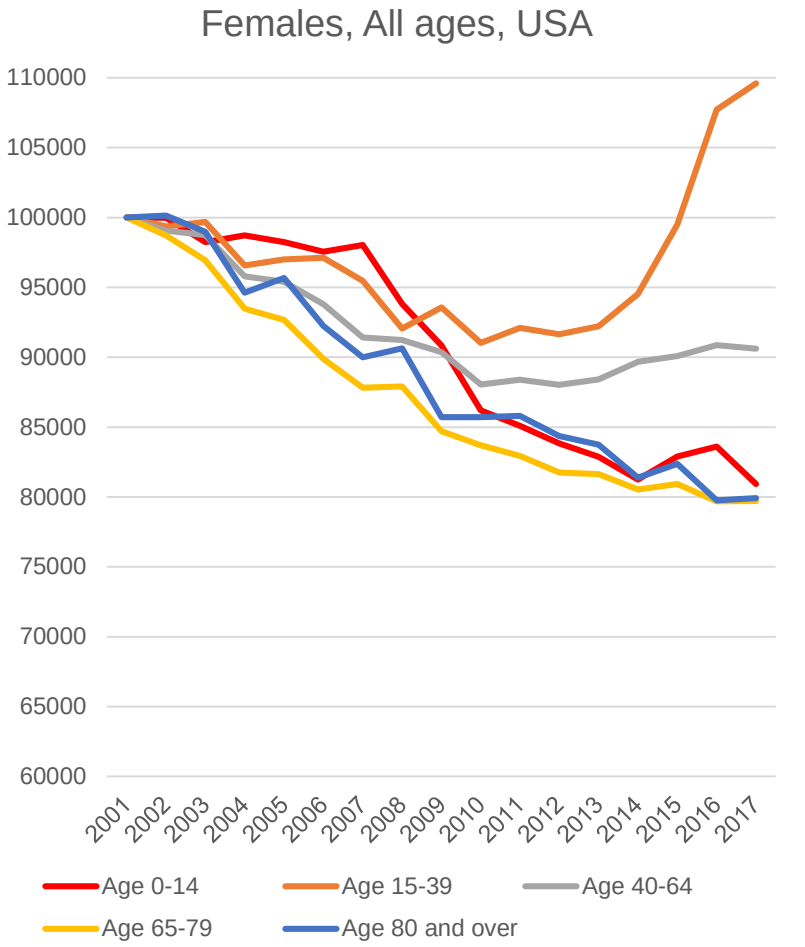
US: Standardised deaths indexed to 100,000 in 2001

Flat period then substantial increase in deaths age 15-39
Predominantly "External causes" and Opioids





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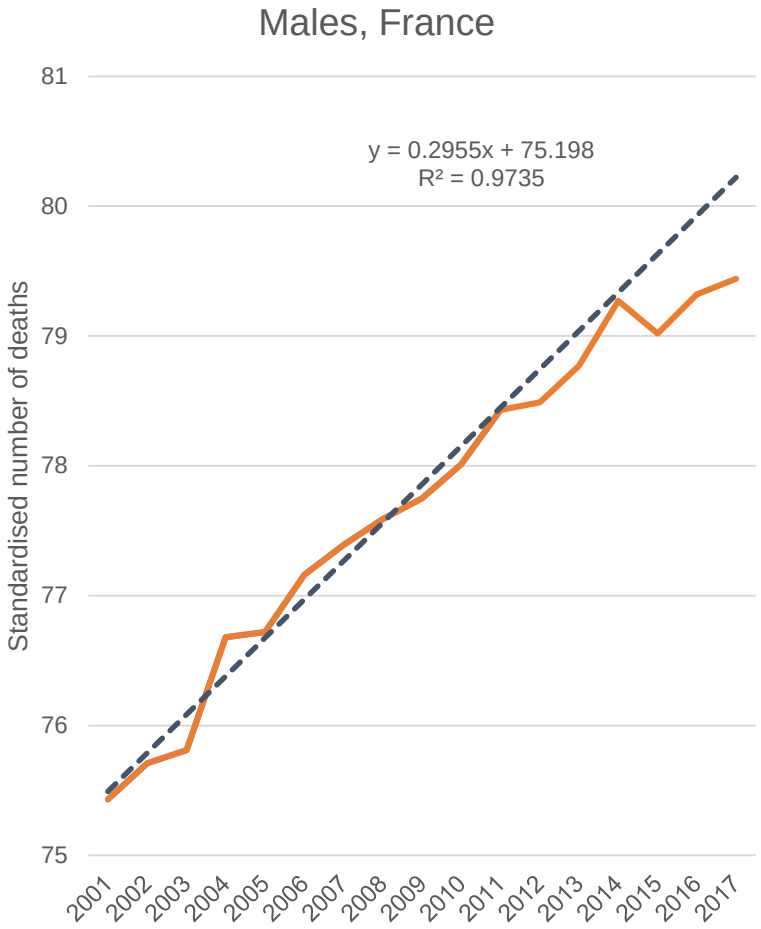
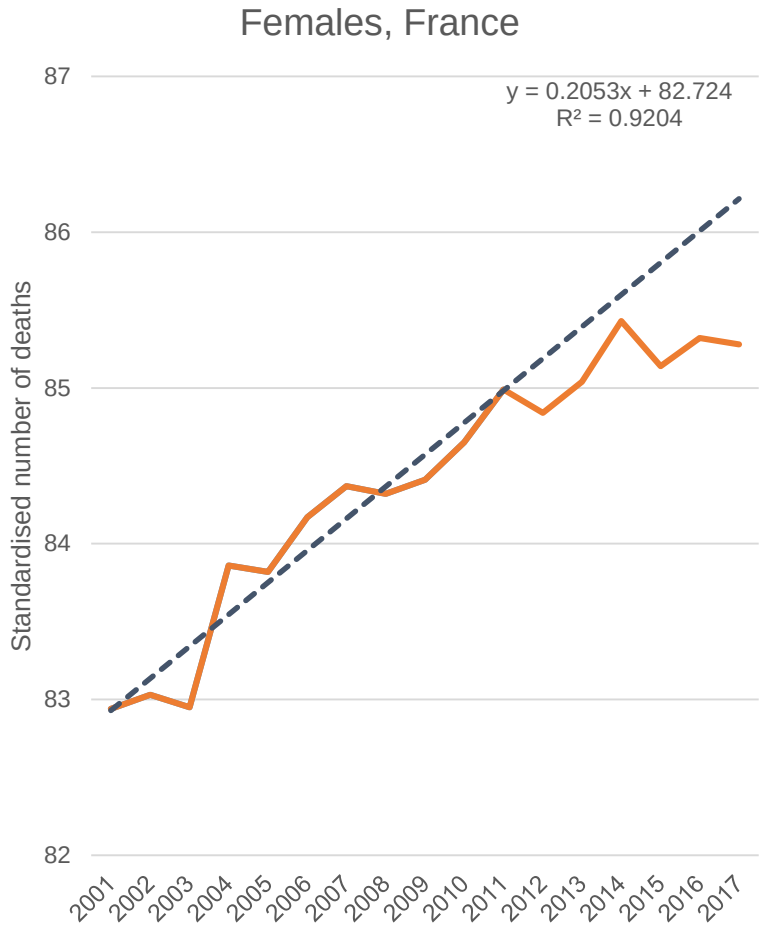
France: Period life expectancy at birth, 2001 to 2017





See also Espérance de vie à divers âges en 2017 Données annuelles de 1994 à 2017, Insee
https://www.insee.fr/fr/statistiques/2416631#Tableau-Donnes Courtesy Marine Habart

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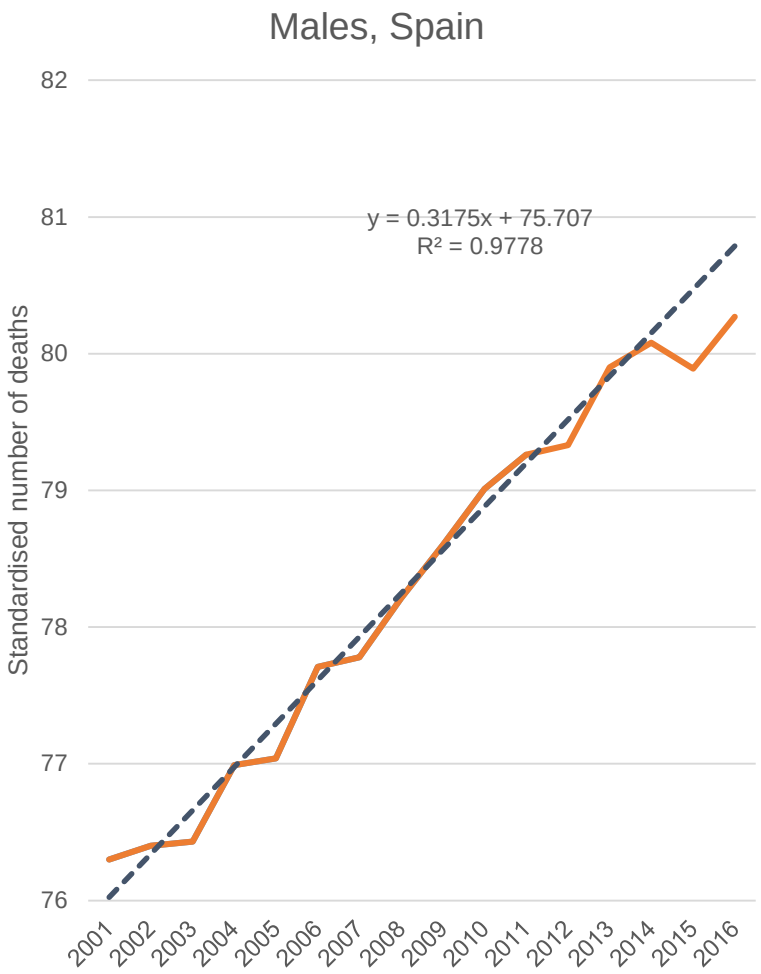
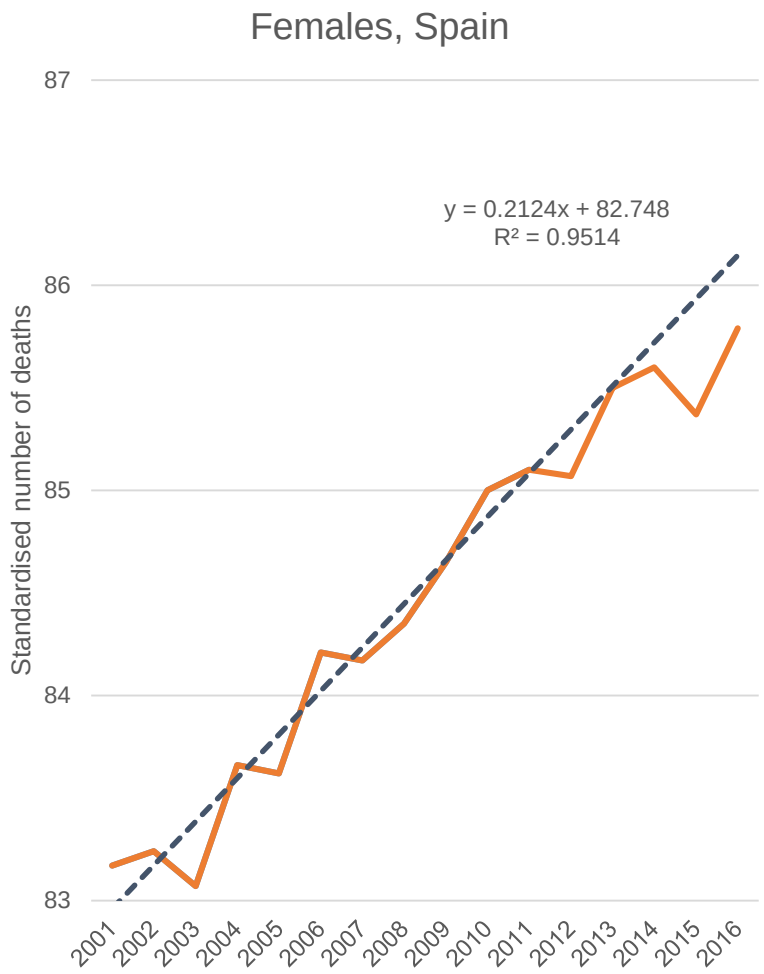
Spain: Period life expectancy at birth, 2001 to 2016





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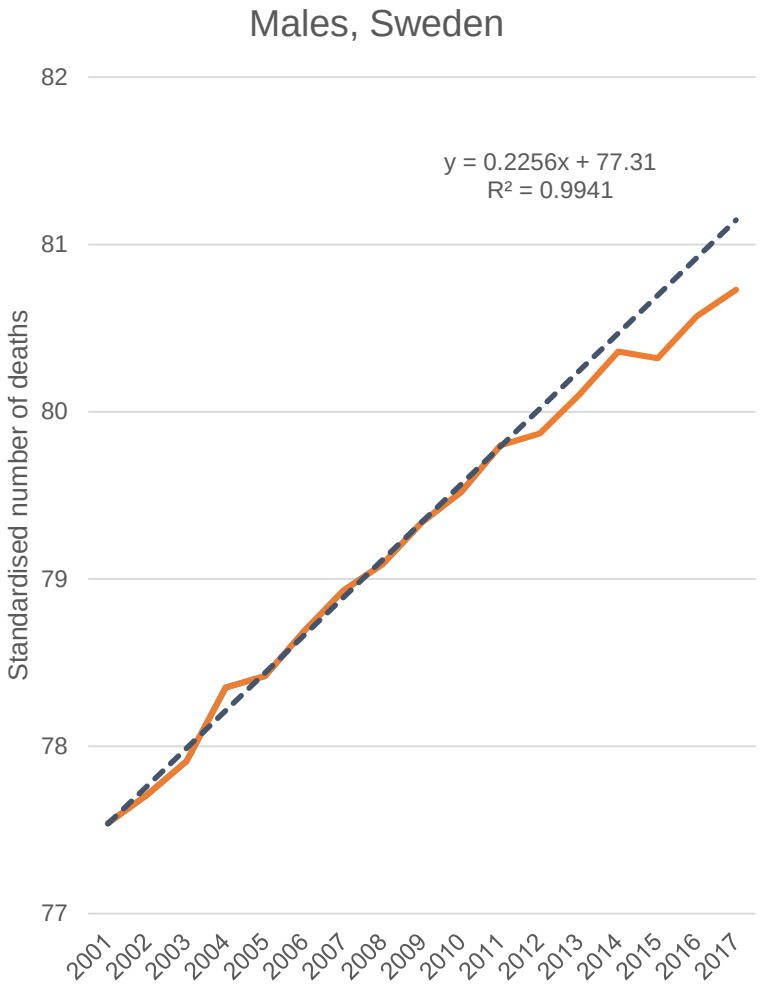
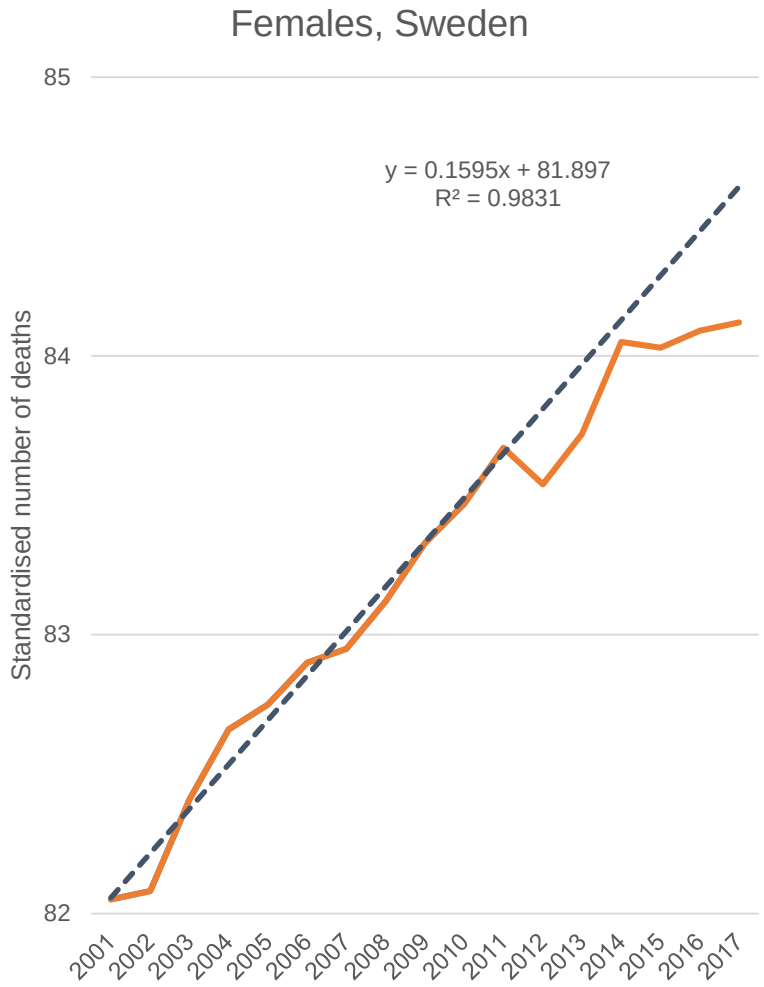
Sweden: Period life expectancy at birth, 2001 to 2017





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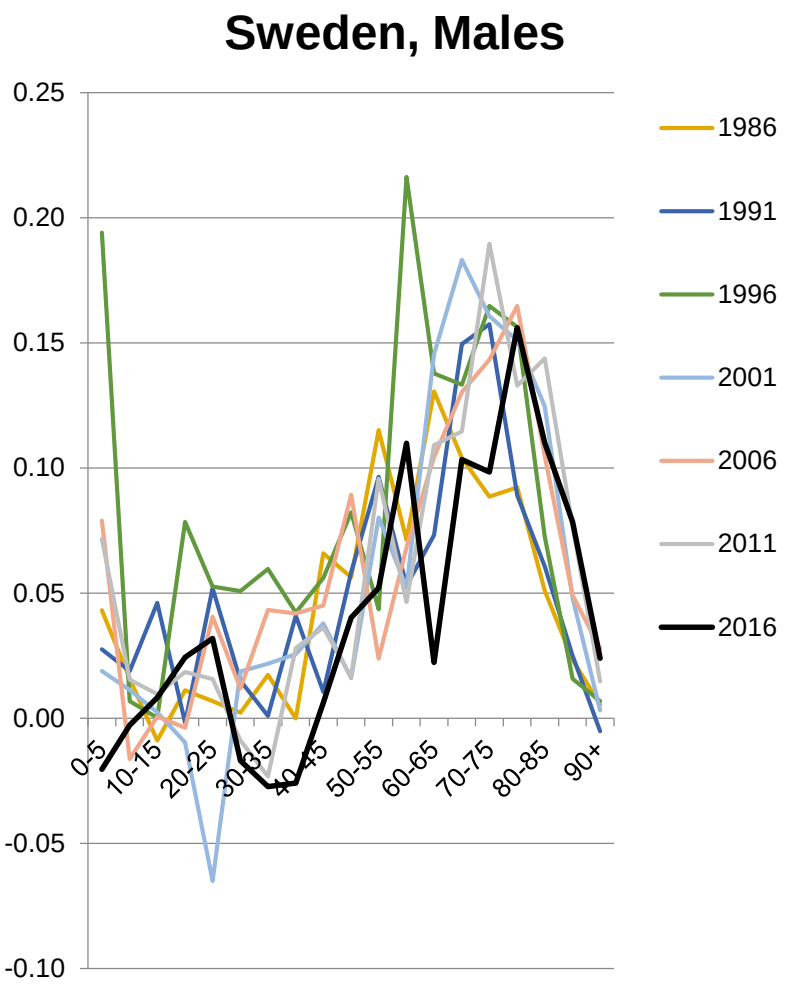
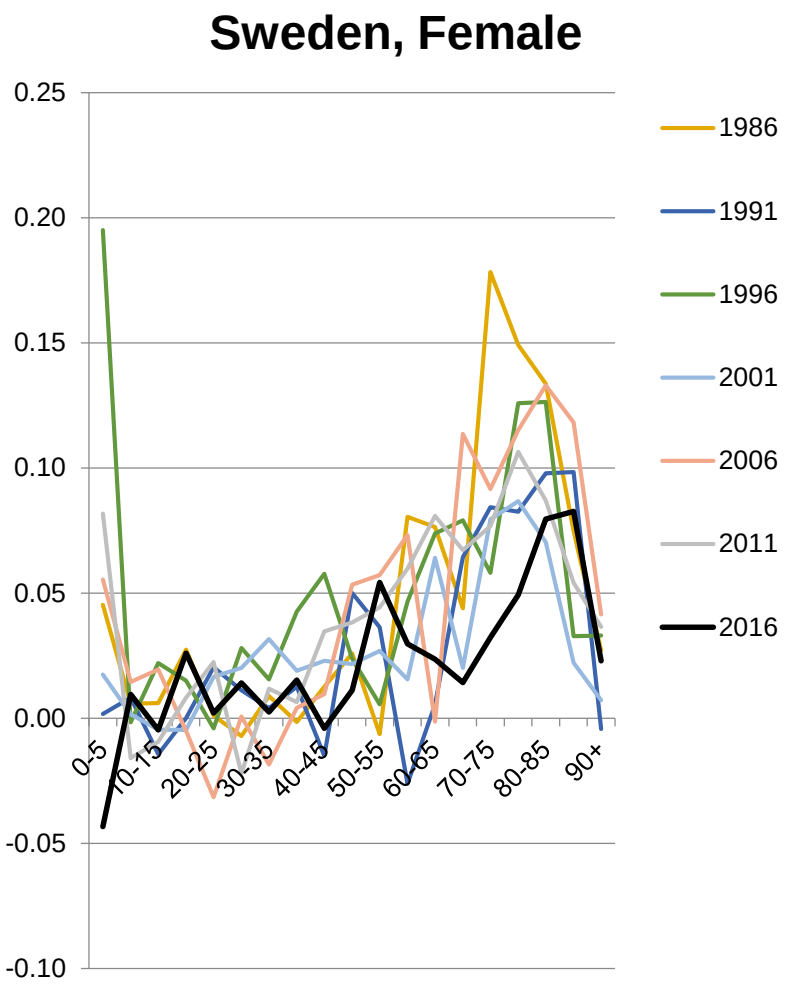
Sweden: Increase in partial life expectancy by 5-year age bands, for 5-year periods ending 1986 to 2016





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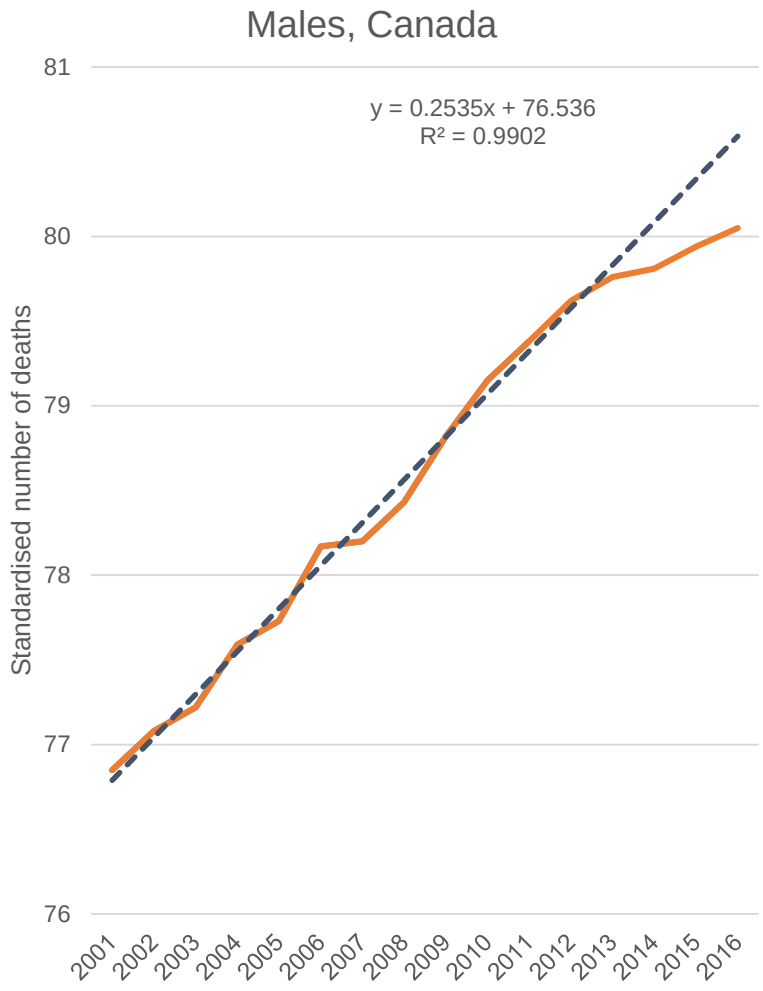
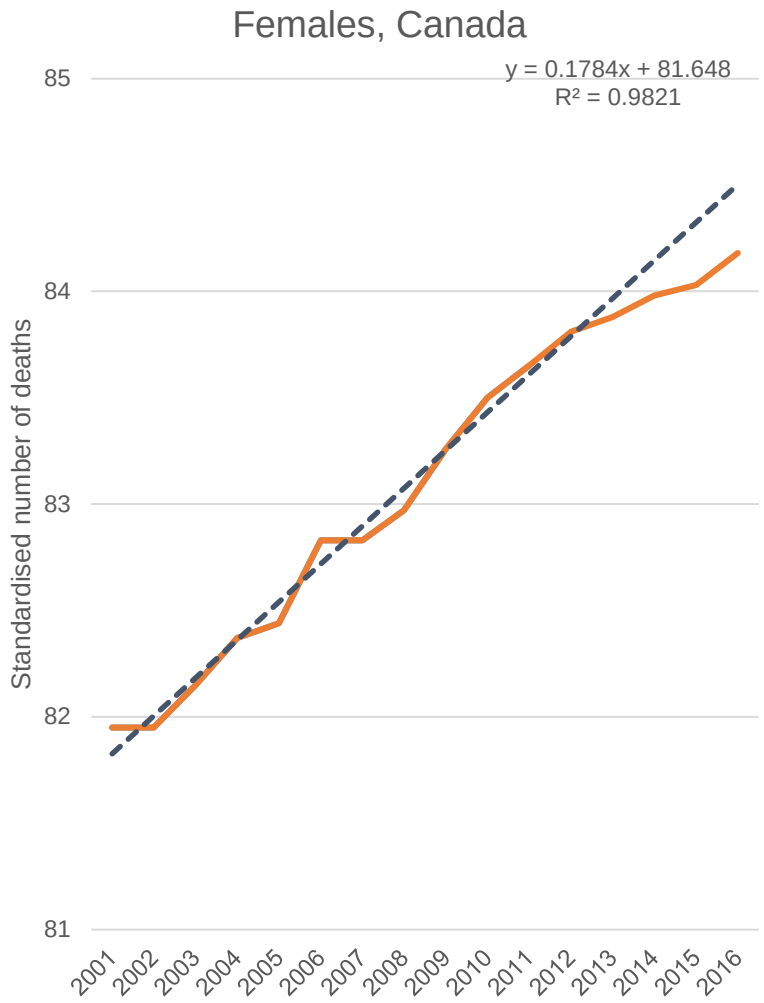
Canada: Period life expectancy at birth, 2001 to 2016





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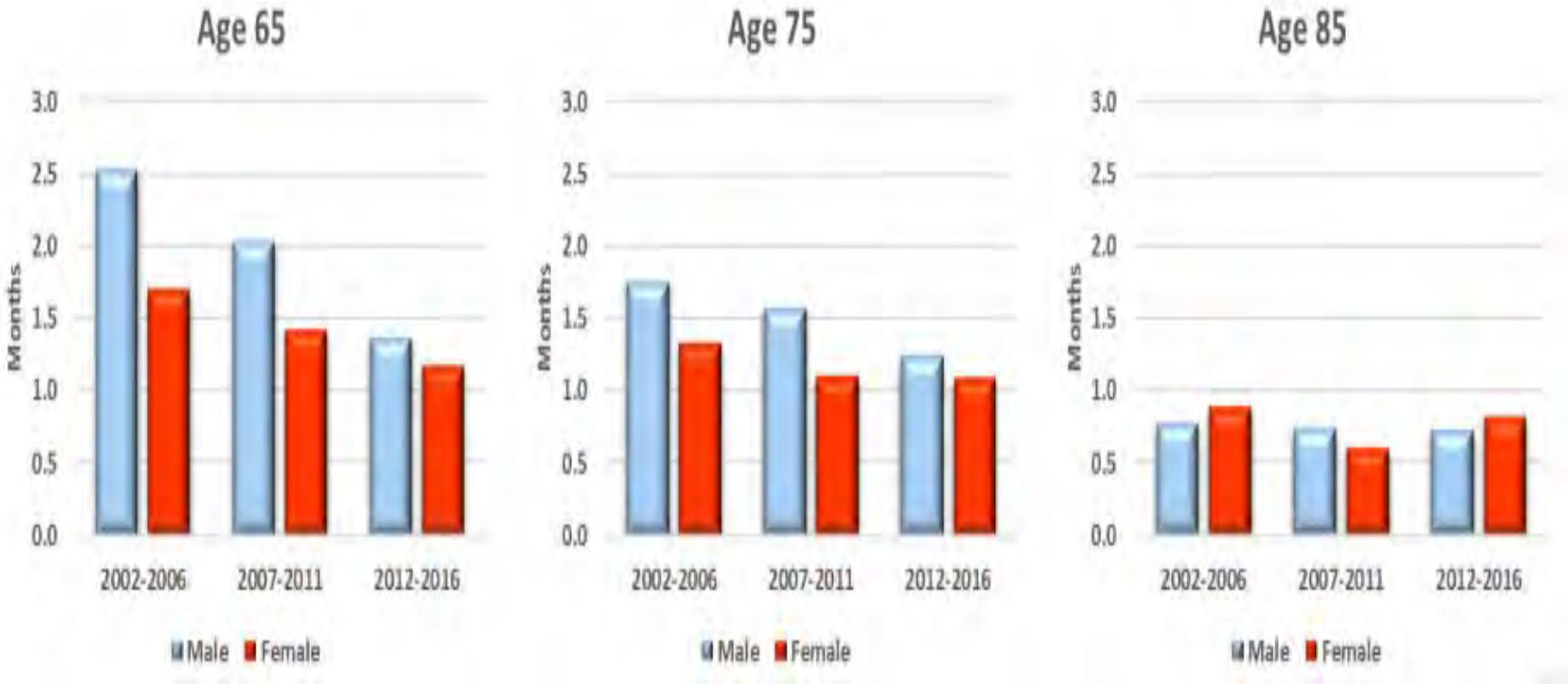
Canada Old Age Security (OAS) Program Mortality Experience

Average annual increase in period life expectancy of OAS Beneficiaries (in months)



Canada, Old Age Security (OAS) Program Mortality Experience Fact Sheet, Office of the Superintendent of Financial Institutions http://www.osfi-bsif.gc.ca/eng/oca-bac/fs-fr/Pages/oas_pme.aspx Courtesy Assia Billig

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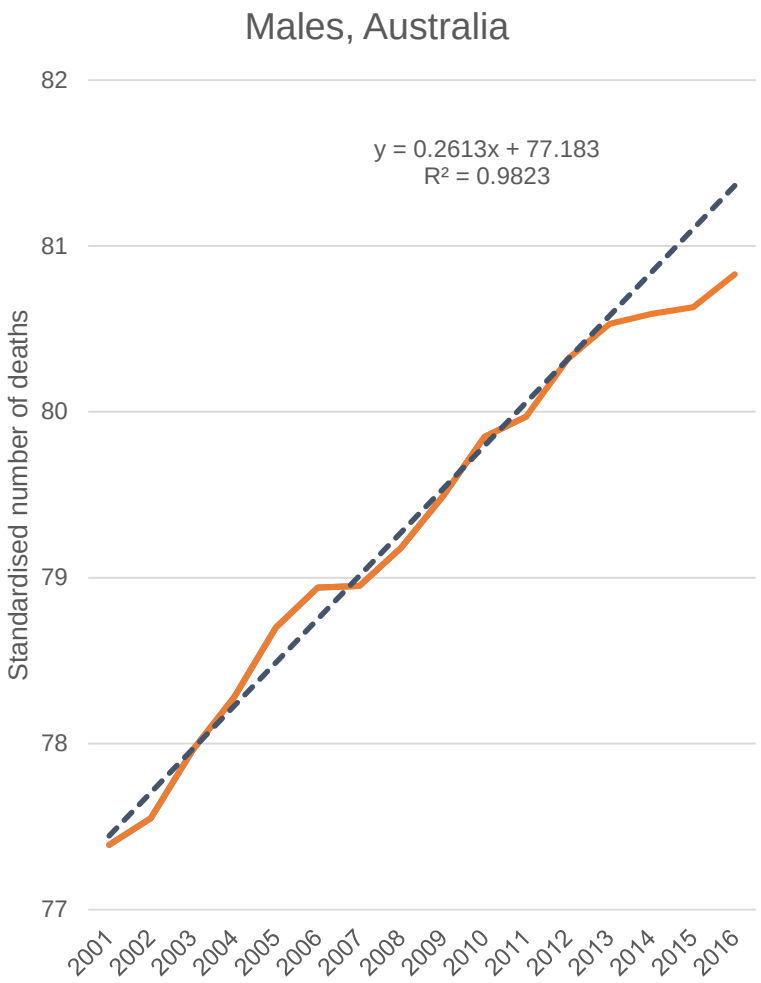
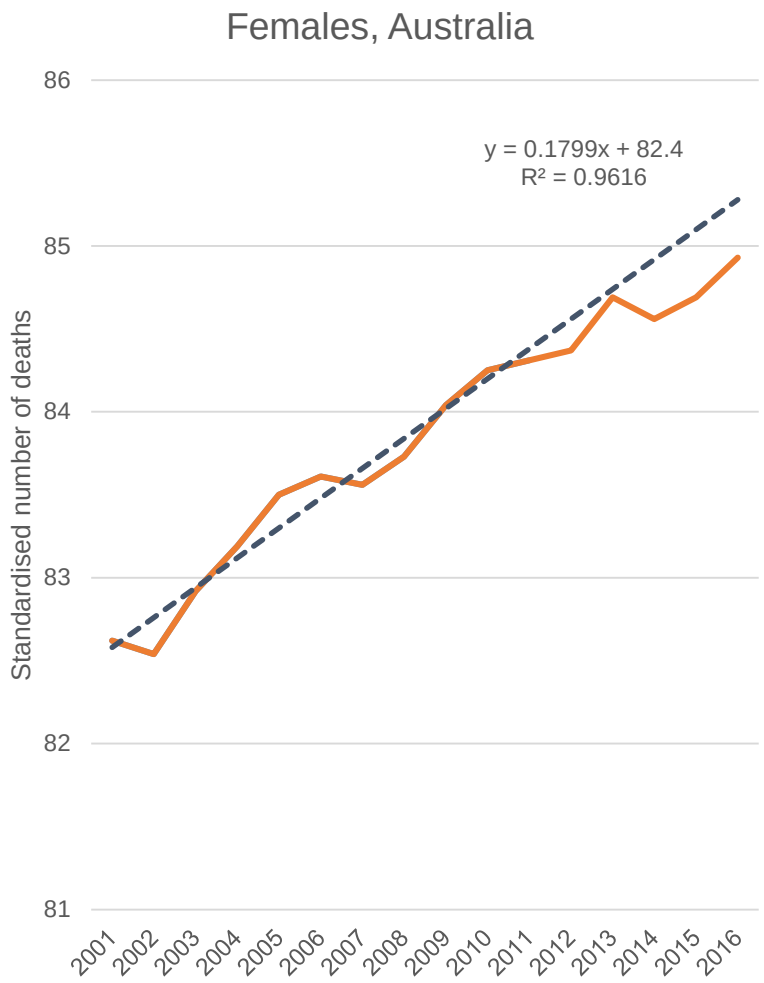
Australia: Period life expectancy at birth, 2001 to 2016





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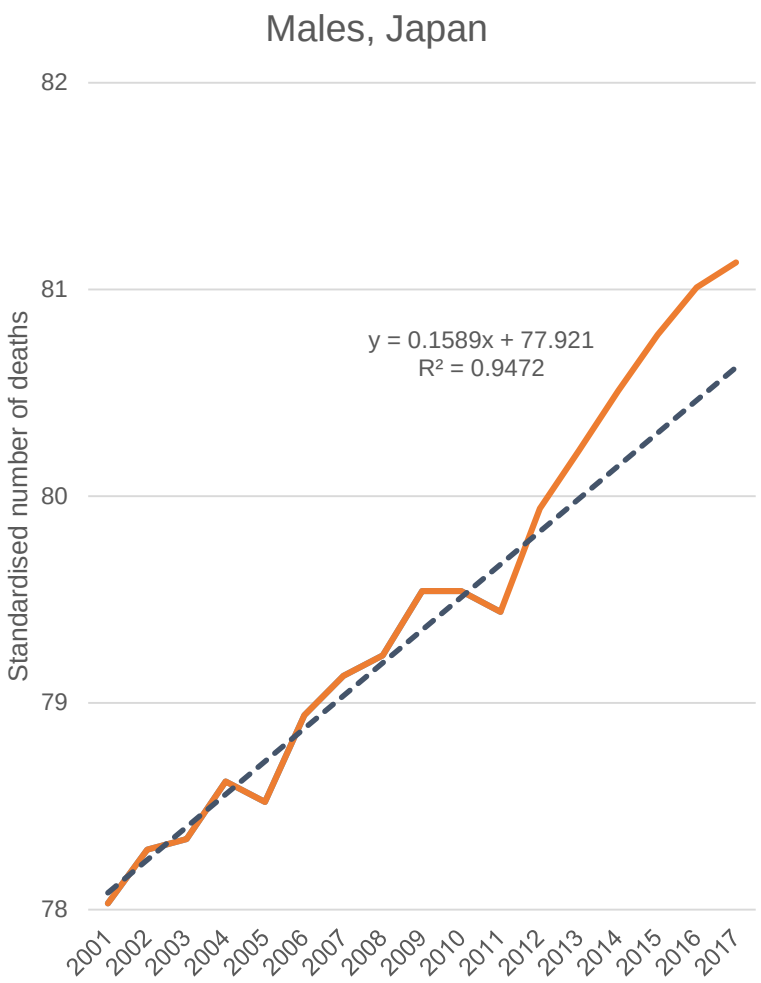
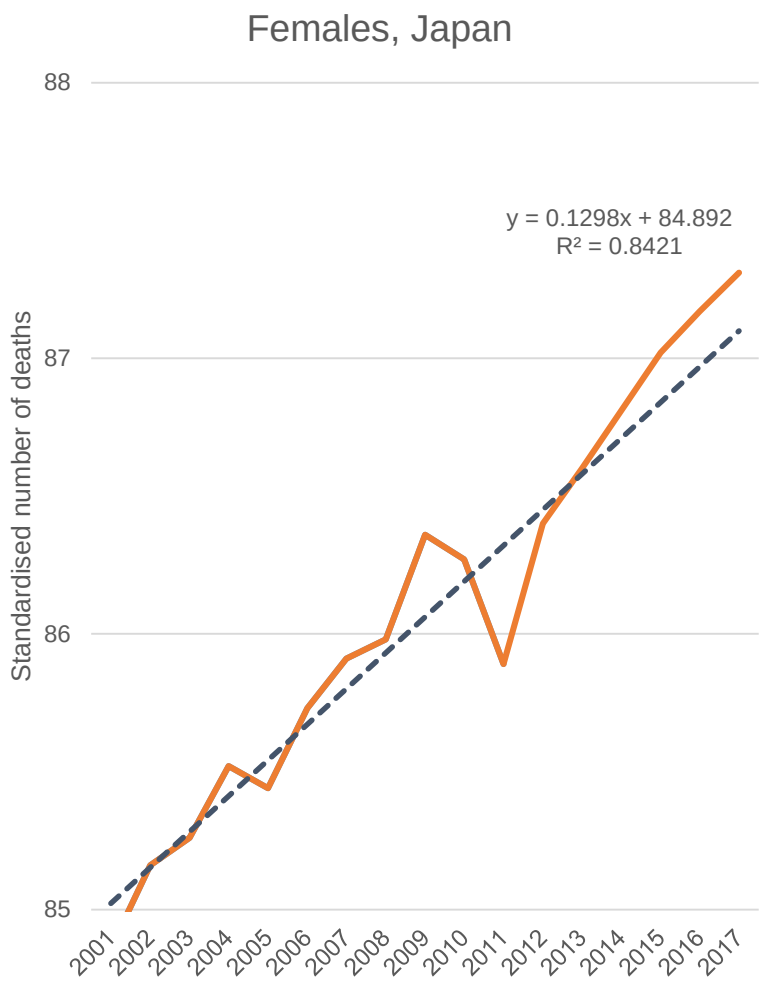
Japan: Period life expectancy at birth, 2001 to 2017





Longevity and death rates, country by country

Analysis: groupings, causes and drivers

What are actuaries, demographers and others doing?

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Groupings, Causes and drivers

Seasonal factors (eg winter mortality)

Causes of death

- "working age" causes (15-64)
- cardiovascular/circulatory/stroke
- dementia

Drivers: behaviours - smoking – obesity

Socio-economic groups and deprivation

Austerity

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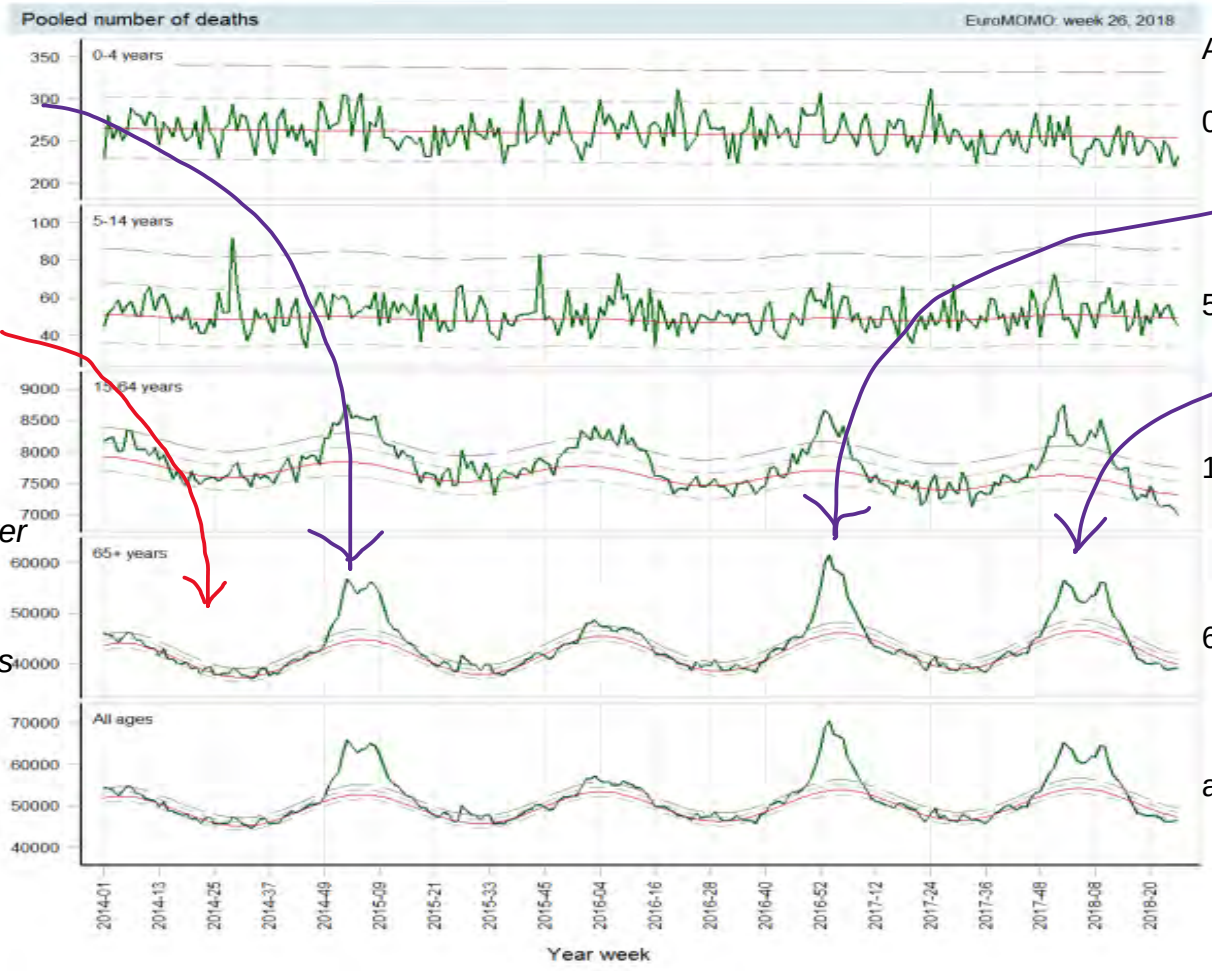
Seasonal mortality – Europe excess winter mortality

Winter 2014/15

Normal excess Winter mortality 2013/14

Scandinavian countries normally experience lower excess winter mortality

… and southern countries (Spain, Portugal) often higher!



Age band

0 – 4

Winter 2016/17

5 – 14

Winter 2017/18

15 – 64

Influenza A(H3N2) inter alia

65 +

all ages

Source: EuroMOMO

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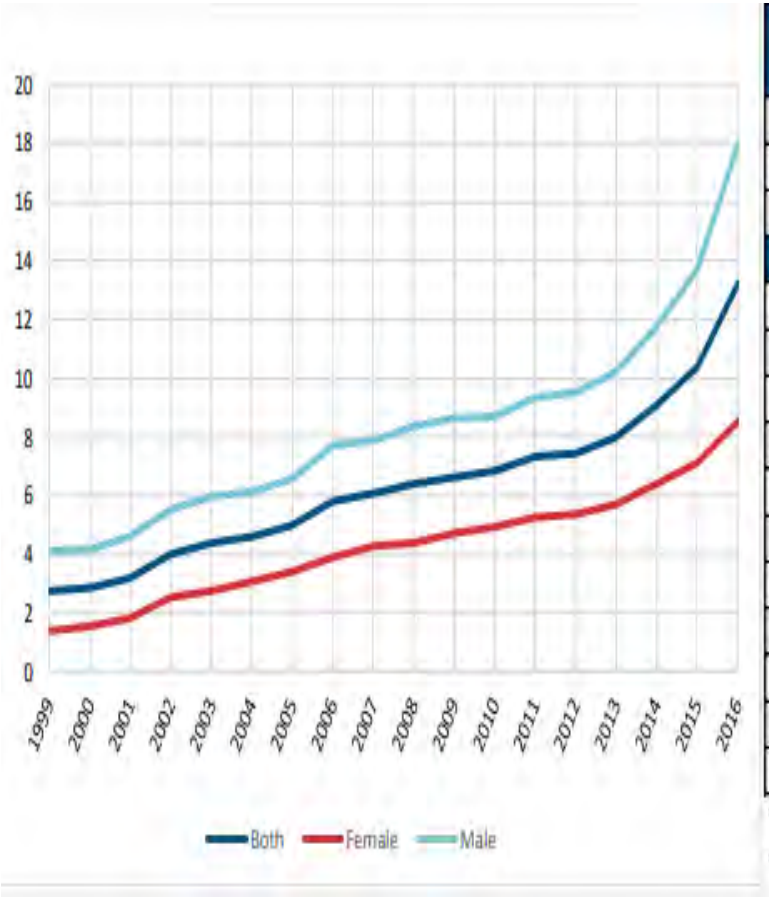
US Opioids: Age adjusted mortality 1999-2016

Deaths per 100,000



All Ages	Annual Improvement 1999-2016	2011-2016	2015-2016
Both	-9.7%	-12.5%	-27.4%
Female	-11.2%	-10.1%	-19.9%
Male	-9.0%	-13.9%	-31.1%
Age Group*			
< 1	**	**	**
1 - 4	**	**	**
5 - 14	**	**	**
15 - 24	-10.9%	-9.8%	-31.7%
25 - 34	-11.4%	-15.4%	-33.2%
35 - 44	-7.4%	-14.1%	-30.6%
45 - 54	-8.3%	-8.7%	-20.6%
55 - 64	-14.7%	-14.5%	-22.5%
65 - 74	-13.1%	-15.6%	-20.8%
75 - 84	-6.1%	-9.7%	-3.2%
85+	-5.8%	0.6%	6.5%

*includes both genders

**Less than 10 deaths. See section 3.

Overall mortality rate (both genders) due to opioid drug overdose increased 27.4% in 2016

U.S. Population Mortality Observations Updated with 2016 Experience, Holman et al. SOA 2018 https://www.soa.org/Files/resources/research-report/2018/us-population-mortality.pdf

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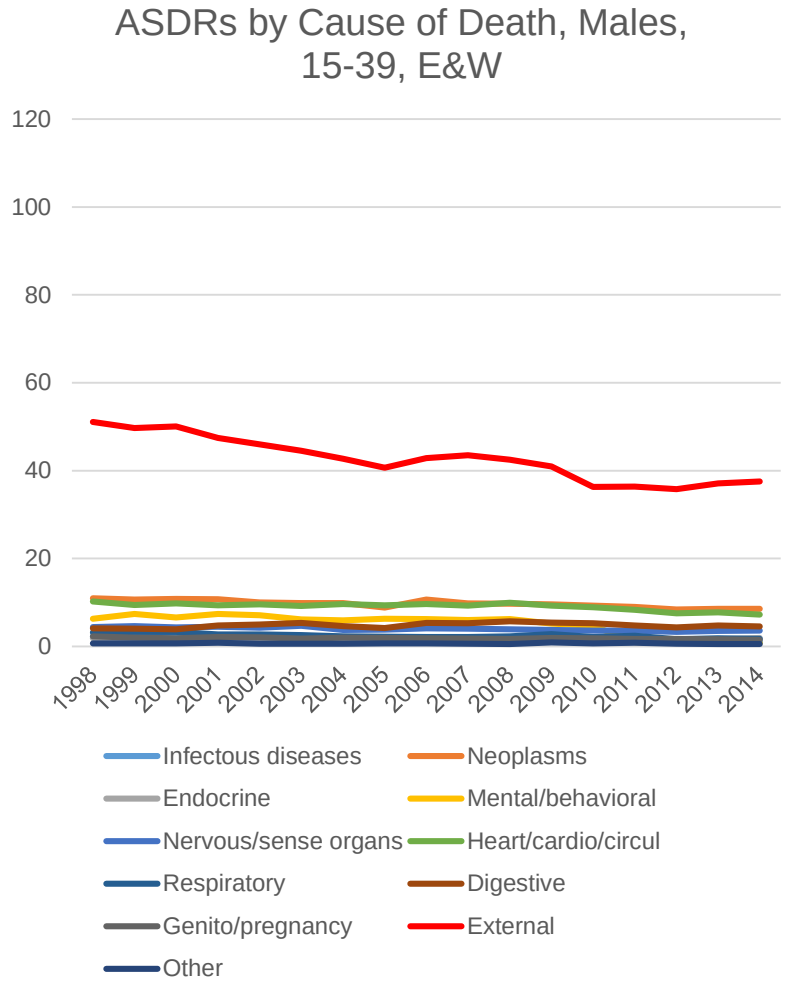
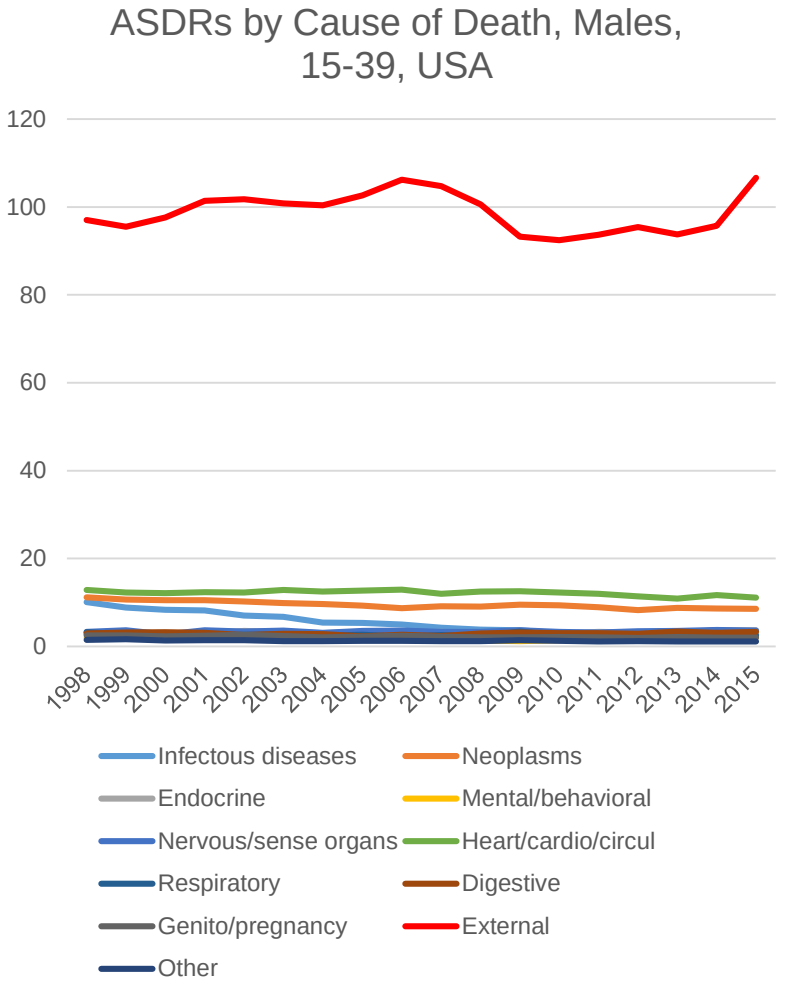
ASDRs by cause of Death, EW v US, Males 15-39





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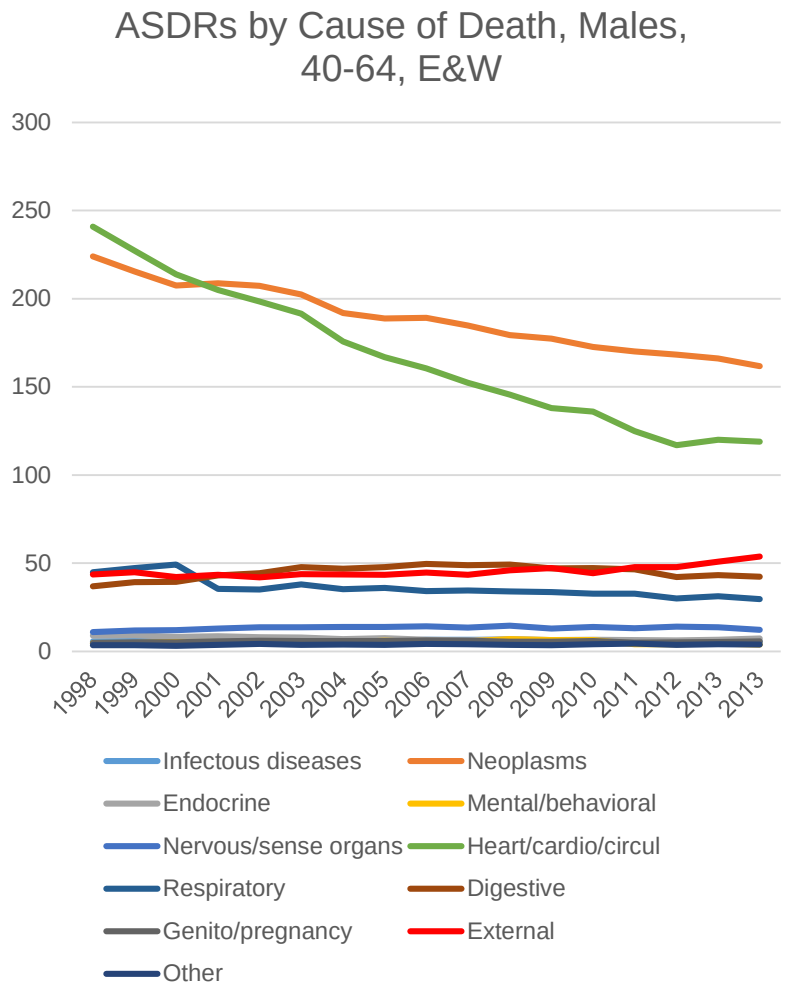
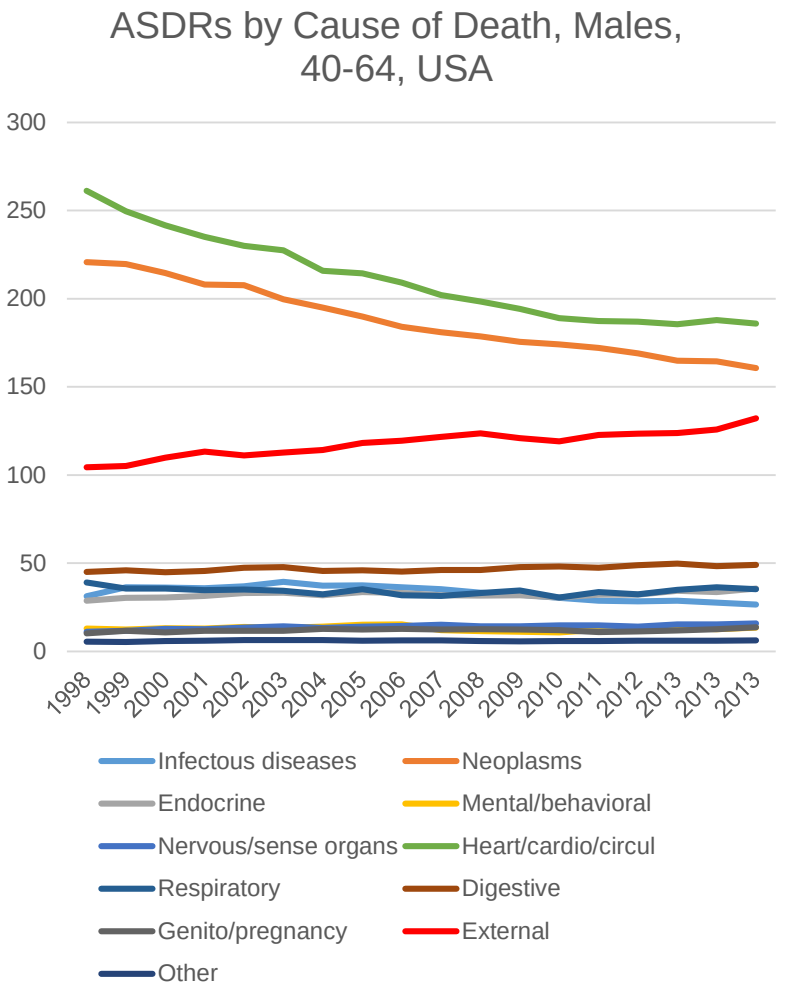
ASDRs by cause of Death, EW v US, Males 40-64





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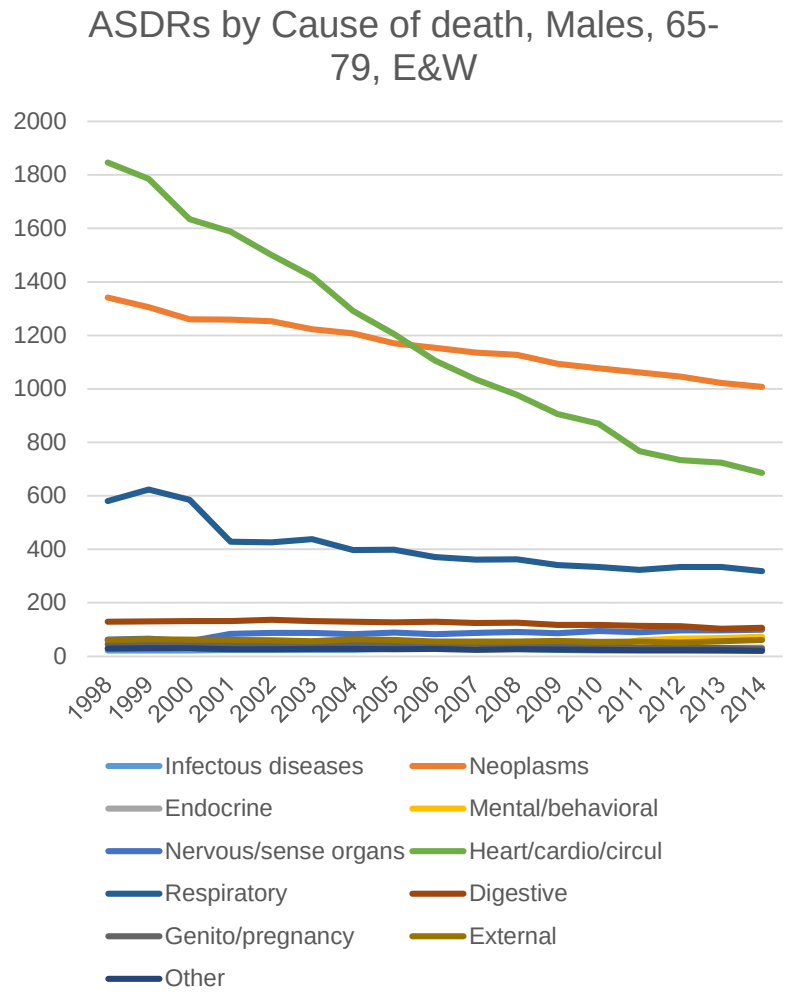
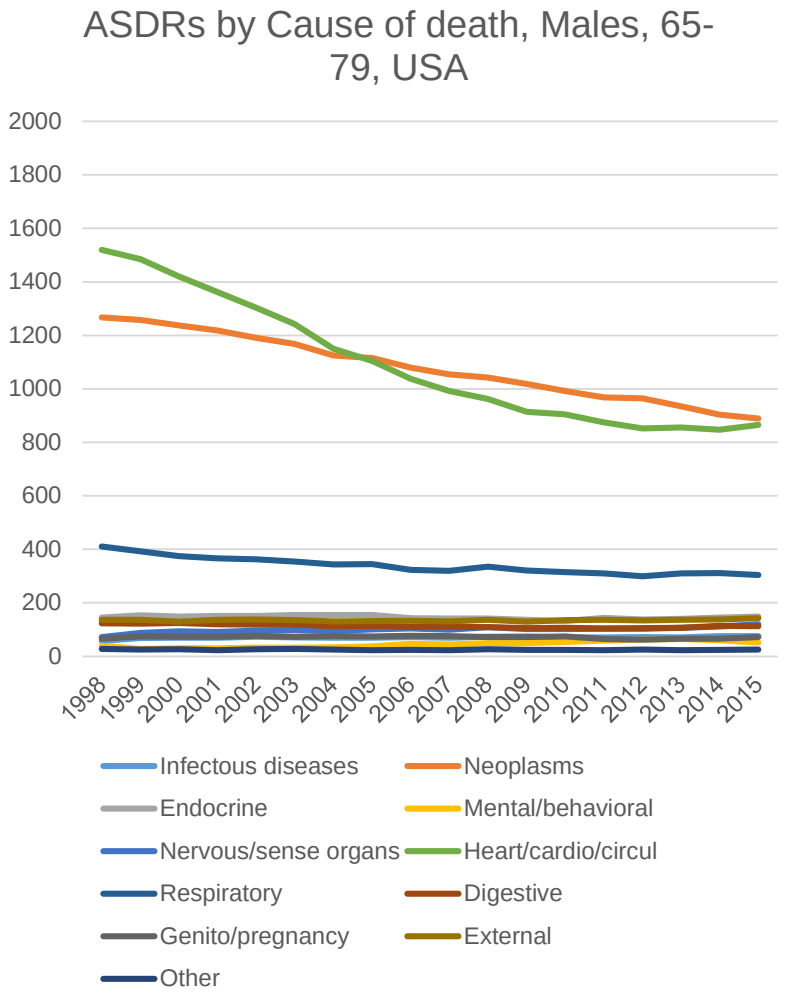
ASDRs by cause of Death, EW v US, Males 65-79





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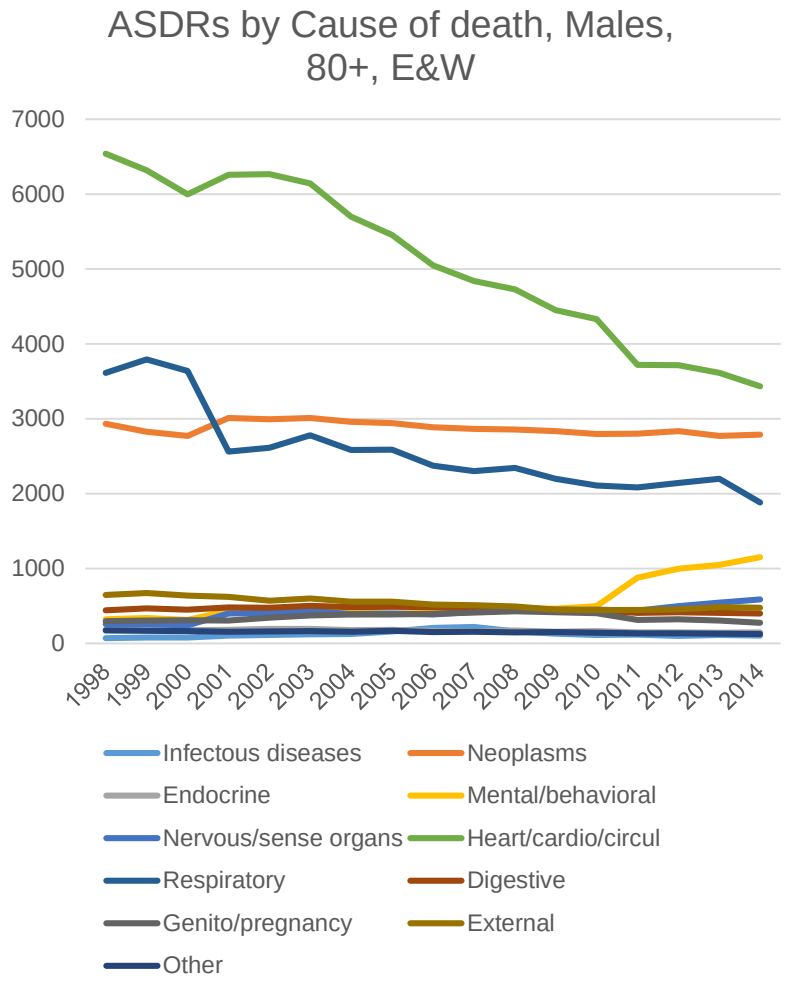
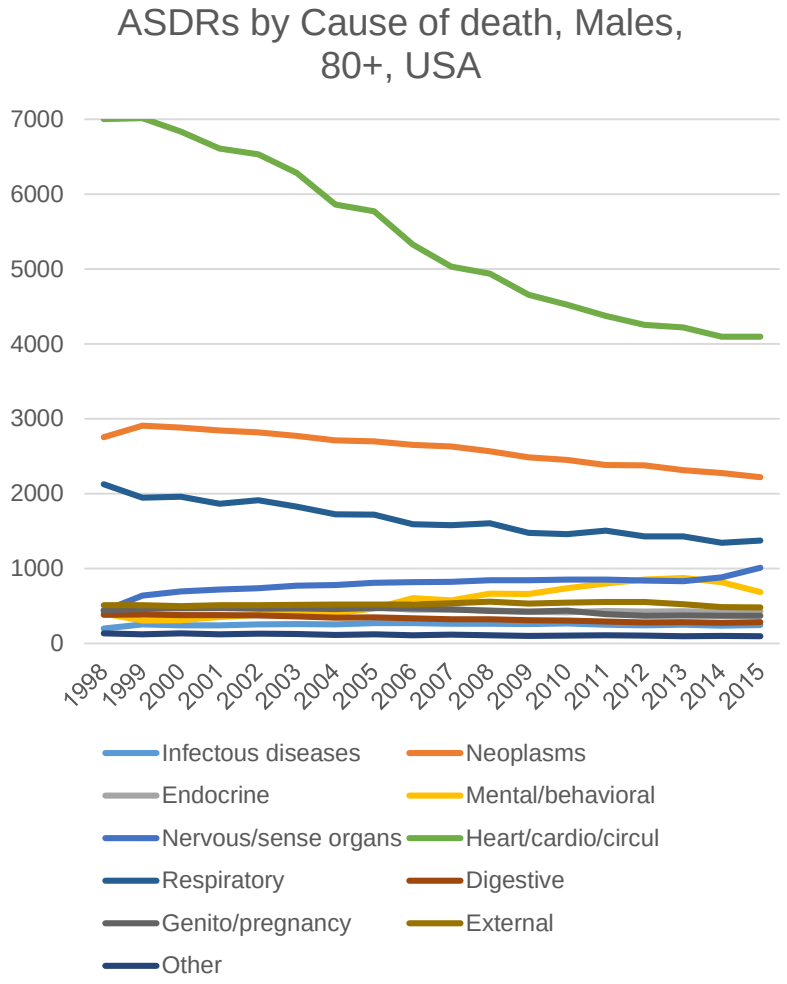
ASDRs by cause of Death, EW v US, Males 80+





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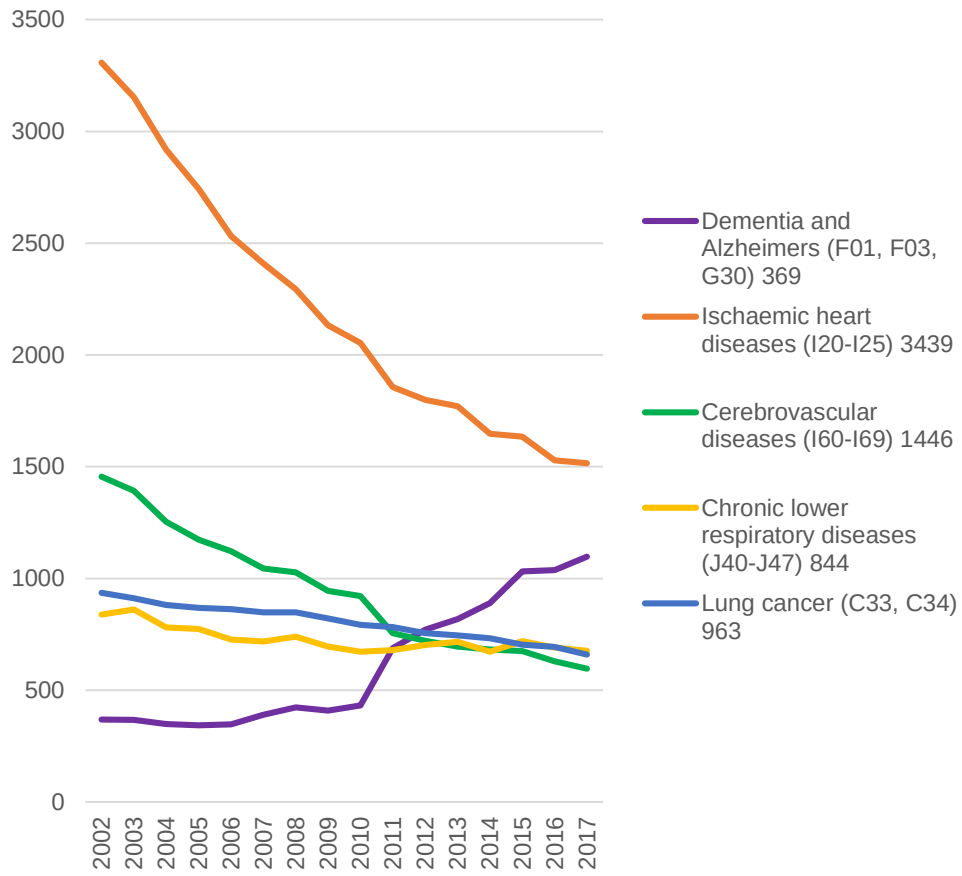
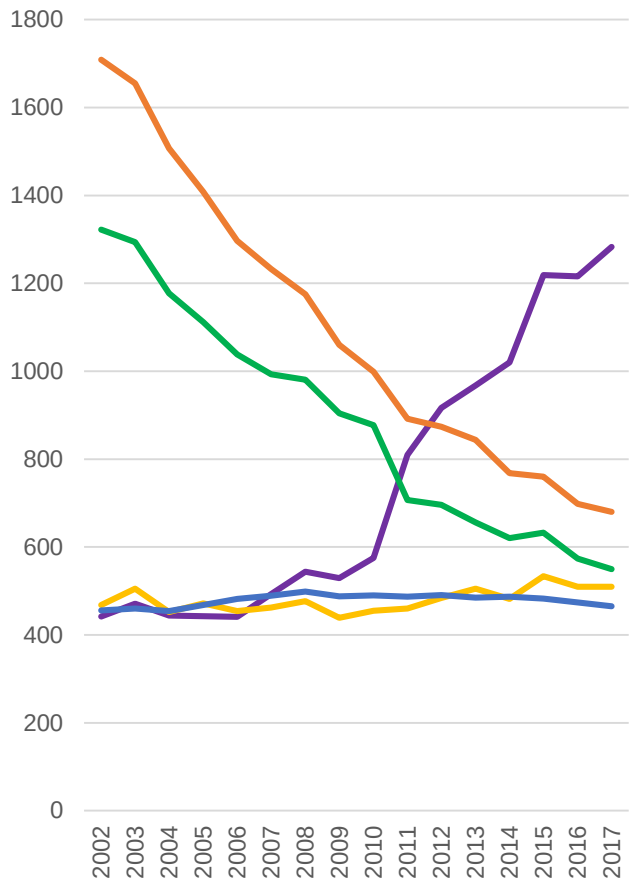
E&W Age standardised mortality rates for top five leading causes of death M, F

(per million population)





Source: ONS, Deaths registered in England and Wales (series DR): 2017

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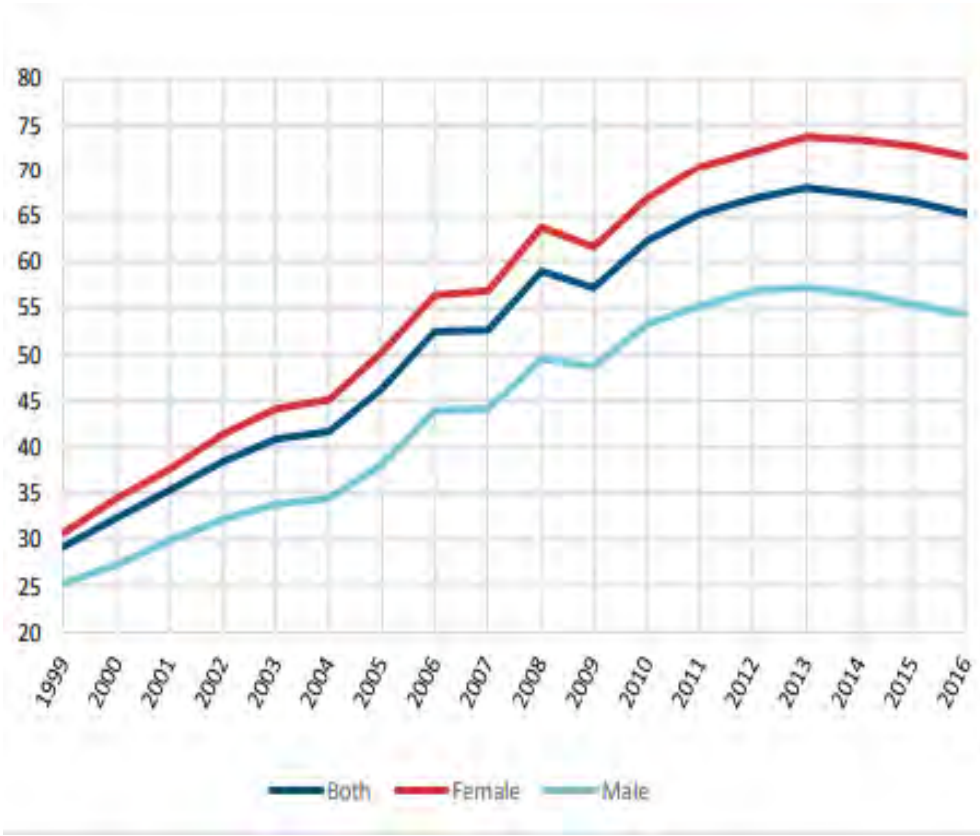
US Alzheimer's/Dementia, age adjusted mortality 1999-2016



All Ages	Annual Improvement 1999-2016	2011-2016	2015-2016
Both	-4.8%	0.0%	1.8%
Female	-5.1%	-0.3%	1.5%
Male	-4.6%	0.4%	2.0%
Age Group*			
< 1	**	**	**
1 - 4	**	**	**
5 - 14	**	**	**
15 - 24	**	**	**
25 - 34	**	**	**
35 - 44	-1.4%	6.1%	30.2%
45 - 54	-3.8%	3.2%	-8.0%
55 - 64	-4.2%	0.1%	-4.3%
65 - 74	-3.6%	0.0%	-1.5%
75 - 84	-4.4%	0.9%	2.6%
85+	-5.1%	-0.4%	1.7%

*includes both genders

**Less than 10 deaths. See section 3.

U.S. Population Mortality Observations Updated with 2016 Experience, Holman et al. SOA 2018 https://www.soa.org/Files/resources/research-report/2018/us-population-mortality.pdf

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Groupings, Causes and drivers

Seasonal factors (eg winter mortality) **Blip? - 3 years in past 5 (Europe)**

Causes of death

"Working age" causes (15-64) US	Blip? Opioids Hard to reverse
Cardiovascular/circulatory/stroke	Blip? Only if the decline in improvements reversed
Dementia	Mixed

NB Considerable variations between countries

Drivers: behaviours – smoking – obesity

Socio-economic groups and deprivation

Austerity

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Drivers: behaviours - smoking – obesity

Behaviours: Account for around 50% of all deaths in US, 45% in UK.
Recent effects US deaths from drug and alcohol poisoning, suicide, and chronic liver disease and cirrhosis

Smoking: Is the effect of past generations quitting smoking now fading out? In UK prevalence in 2016 had fallen to 16%. Higher smoking prevalence in routine/manual occupations than professional/managerial.

Obesity: Is the effect increasing? In 2016, 61% of adults in England overweight or obese; little change since 2000. For children aged 2 – 15 prevalence of overweight/obese rose from 25% in 1993 to 34% in 2004; currently 28% in 2016.

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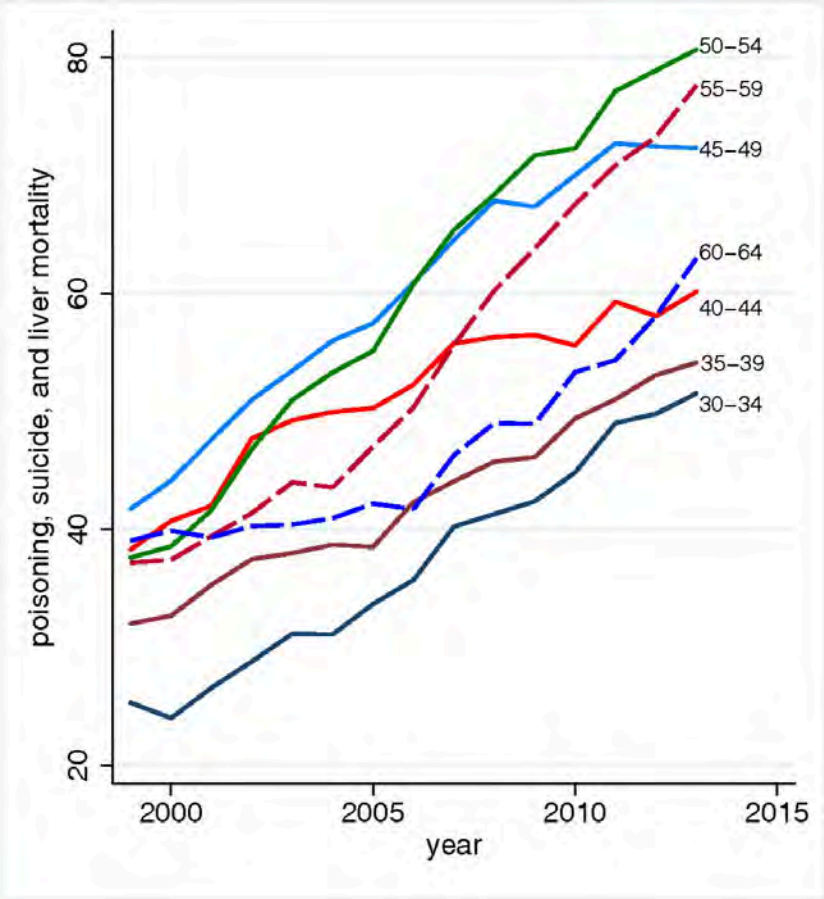
US Behaviours: all age groups from 30-64



All 5-y age groups between 30–34 and 60–64 have witnessed marked and similar increases in mortality from the sum of drug and alcohol poisoning, suicide, and chronic liver disease and cirrhosis over the period 1999–2013

Case, A.; Deaton, A. (2015). Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century. Proceedings of the National Academy of Sciences (2015) 112

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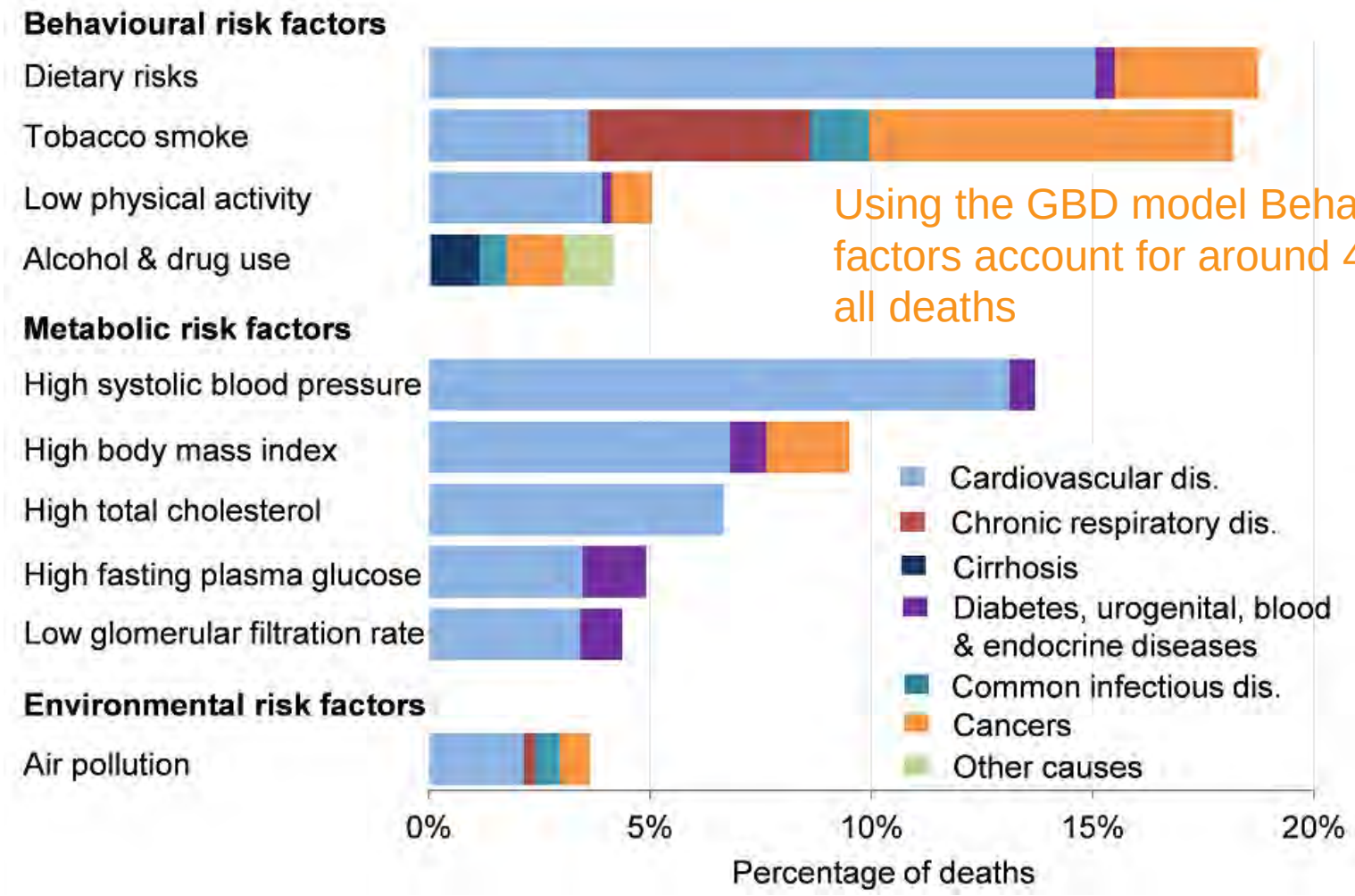
Behaviours: Risk factors, England, all ages



Using the GBD model Behavioural factors account for around 45% of all deaths

Source: Health profile for England, Chapter 2: major causes of death and how they have changed July 2017
https://www.gov.uk/government/publications/health-profile-for-england/chapter-2-major-causes-of-death-and-how-they-have-changed

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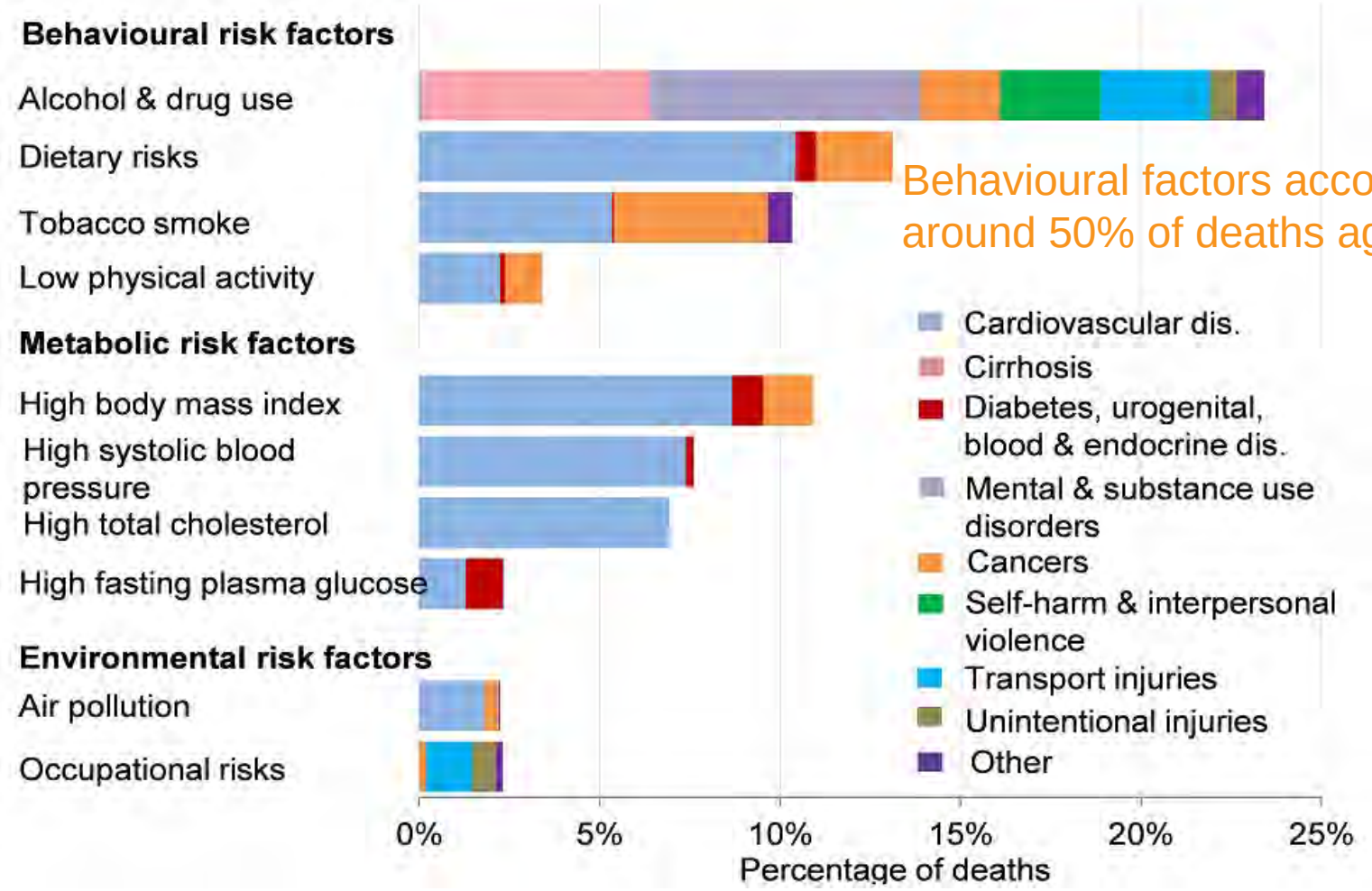
Behaviours: Risk factors, England, age 15-49



Behavioural factors account for around 50% of deaths age 15-49

Source: Health profile for England, Chapter 2: major causes of death and how they have changed July 2017
https://www.gov.uk/government/publications/health-profile-for-england/chapter-2-major-causes-of-death-and-how-they-have-changed

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Drivers: Socio-economic factors, Austerity

Socio-economic factors: US, UK – Socio-economic gap increasing

Austerity: Europe, US

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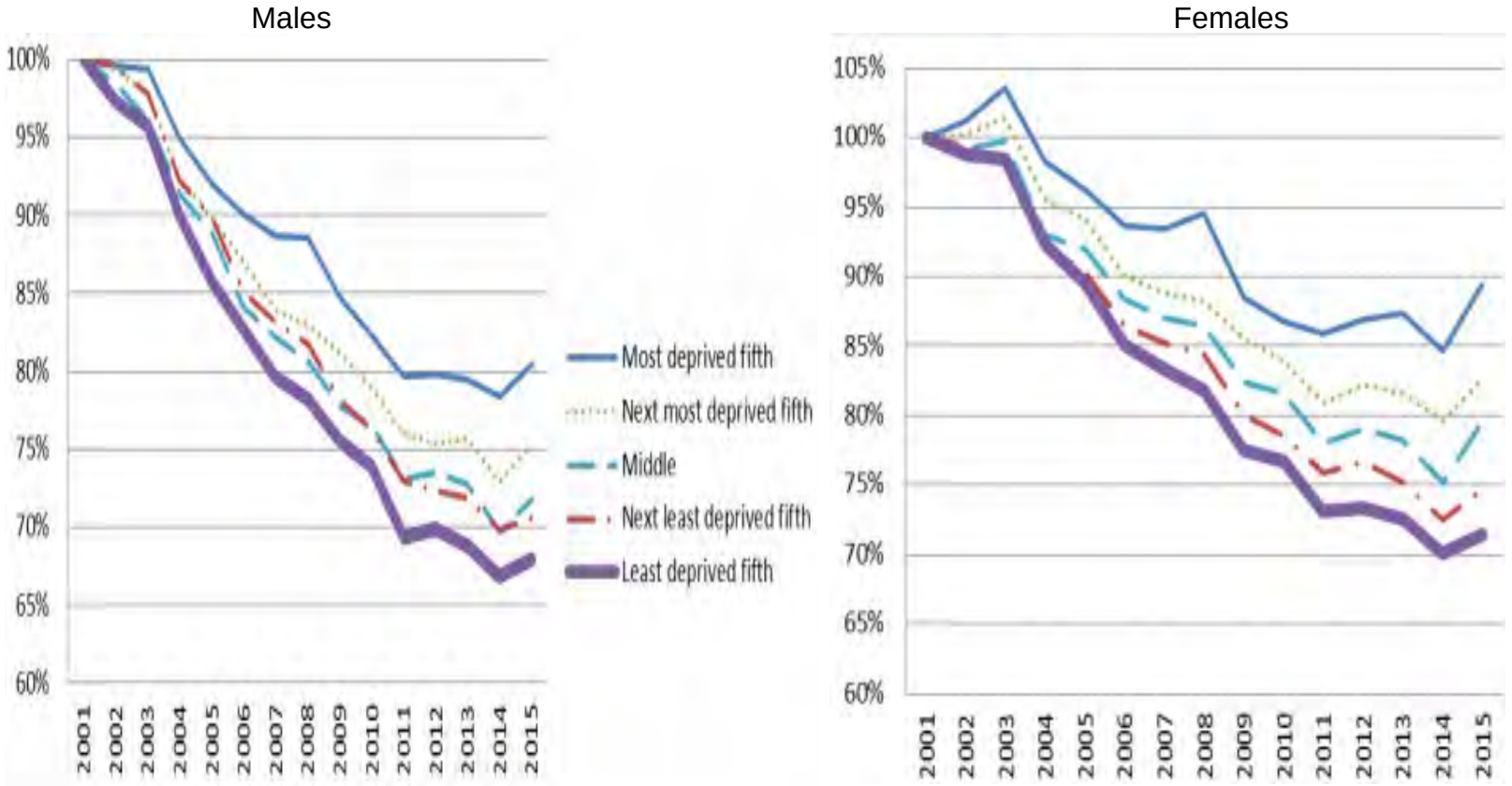
England: Socio-economic gap

Progression of death rates for those aged 60-89 of each socioeconomic circumstances quintile – mortality given as a percentage of that in 2001



Source: Life expectancy: is the socio-economic gap narrowing? Longevity Science Panel 2018

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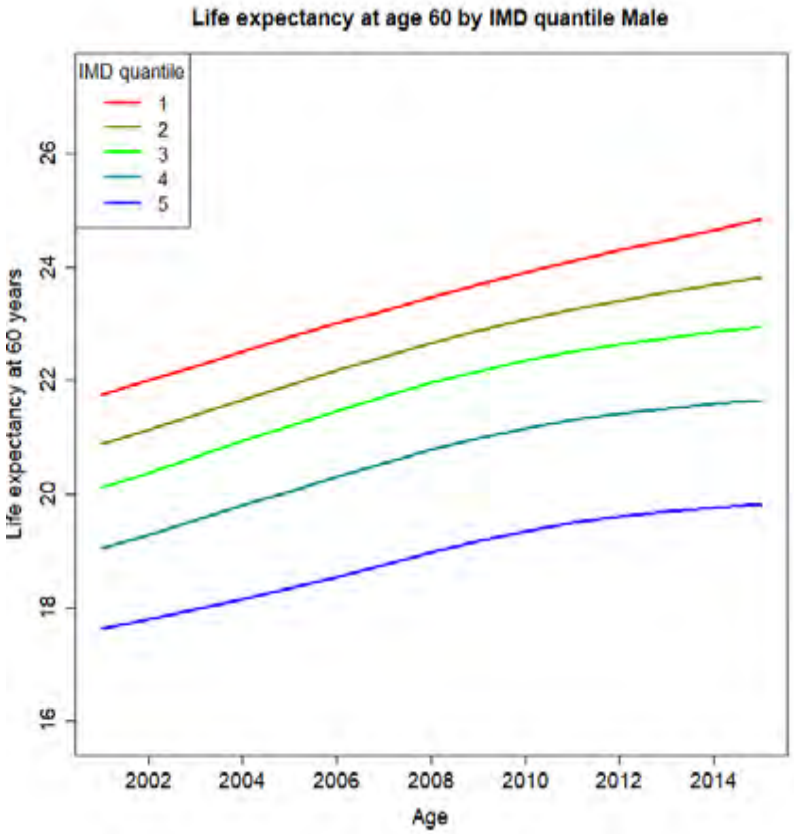
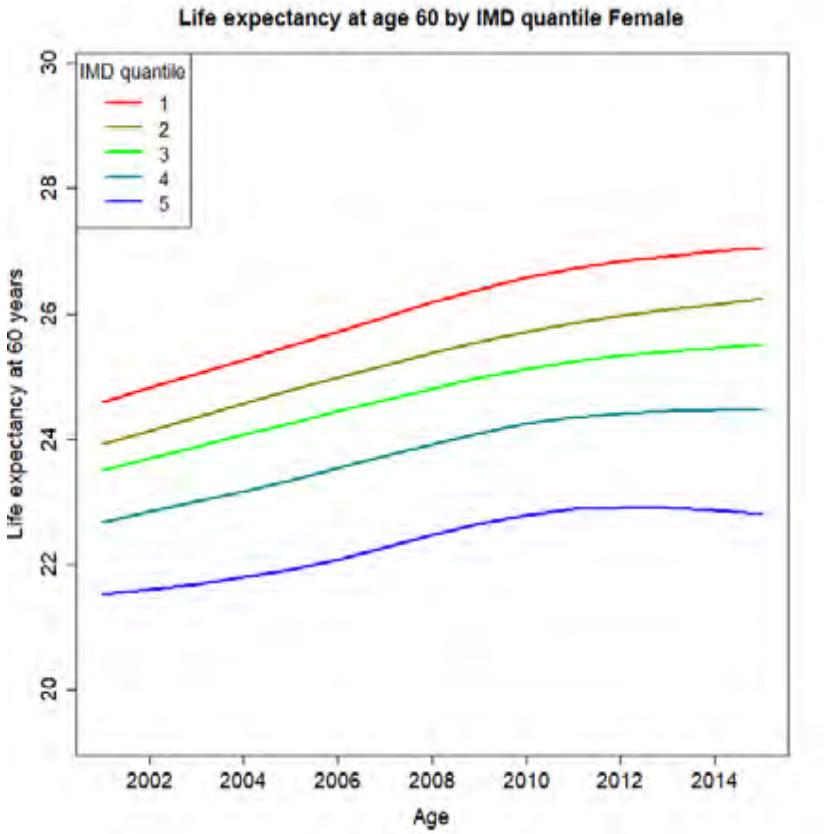
England: Socio-economic gap





Source: Life expectancy: is the socio-economic gap narrowing? Longevity Science Panel 2018

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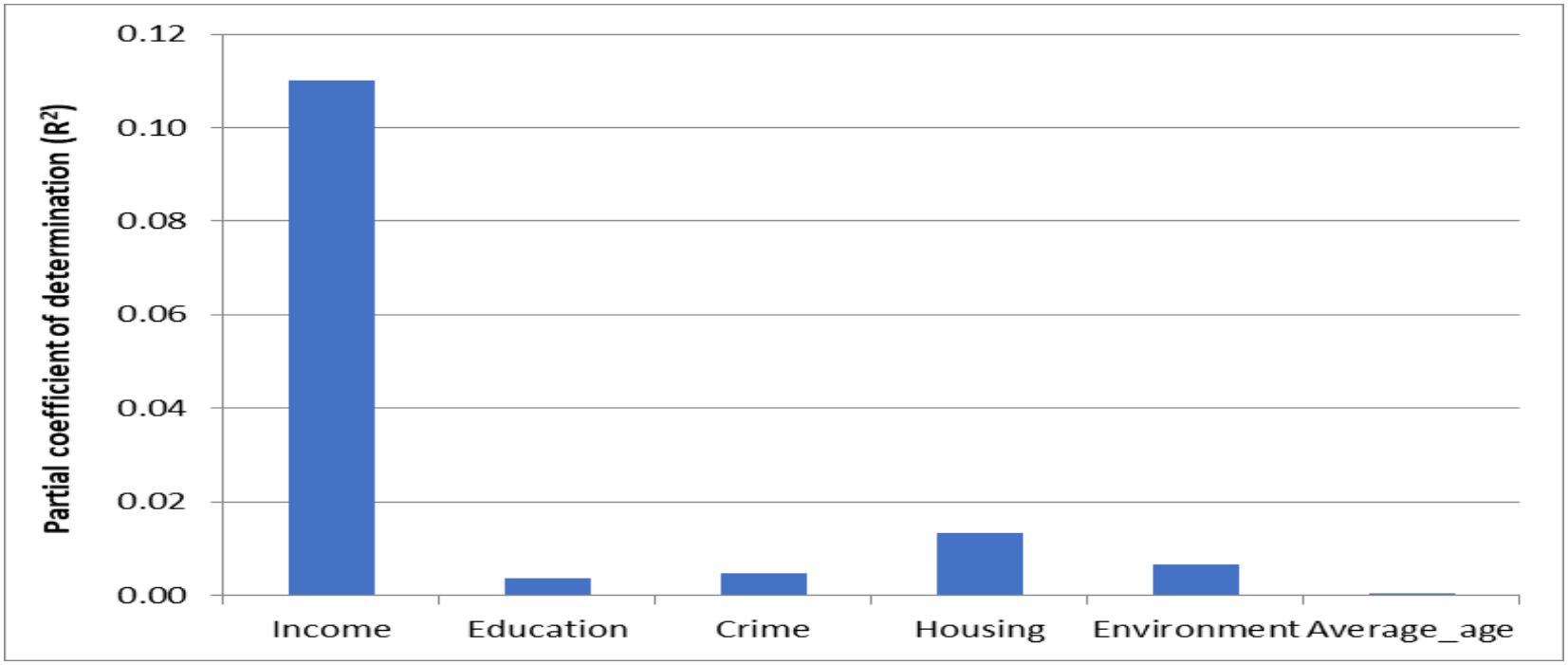
Independent predictors

Partial coefficients of determination for each independent variable in the regression analysis



It's mainly about money

"Of the many factors including income, education, crime, health, housing, environment and unemployment, **income deprivation** is the strongest independent predictor of mortality rates"

Source: Life expectancy: is the socio-economic gap narrowing? Longevity Science Panel 2018

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Longevity Science Panel report - conclusions

- Life expectancy increased in all age and quintiles
- Inequalities in LE linked to social deprivation have increased since 2001
- Especially in the elderly and greatest in working age adults
- Differences in life-expectancy between the rich and poor in England have widened between 2001 and 2015
- Death rates have fallen faster for those more advantaged between 2001 and 2015
- Income deprivation is the strongest independent predictor of mortality rates in a neighbourhood

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Austerity – mixed messages

EUROPE: "The slowing down of improvements in life expectancy, correlated to the level of austerity, raises uncomfortable questions as to whether we are beginning to transition from the era of consistently improving population health to a new age characterised by an instability in population health largely dictated by the social and political determinants of health."

"While the causes of this phenomenon are contested, there is growing evidence to point to the austerity policies implemented in recent years as at least a partial explanation."

"While income inequality has increased in both the United States and France, inequality in mortality in France remained remarkably low and stable."

Patterns have varied between countries with some which experienced more severe austerity (e.g. Ireland, Spain, Portugal) doing better than those which experienced less austerity (e.g. Germany, Netherlands)

Source: Austerity and the new age of population health? Mark A Green, Scandinavian Journal of Public Health
Source: Why is life expectancy in E&W stalling, Hiam et al, BMJ
Source: Mortality (in)equality in France and the United States, J Currie et al National Bureau of Economic Research, Cambridge, MA

Longevity and death rates, country by country

Analysis: groupings, causes and drivers

What are demographers, actuaries and others doing?

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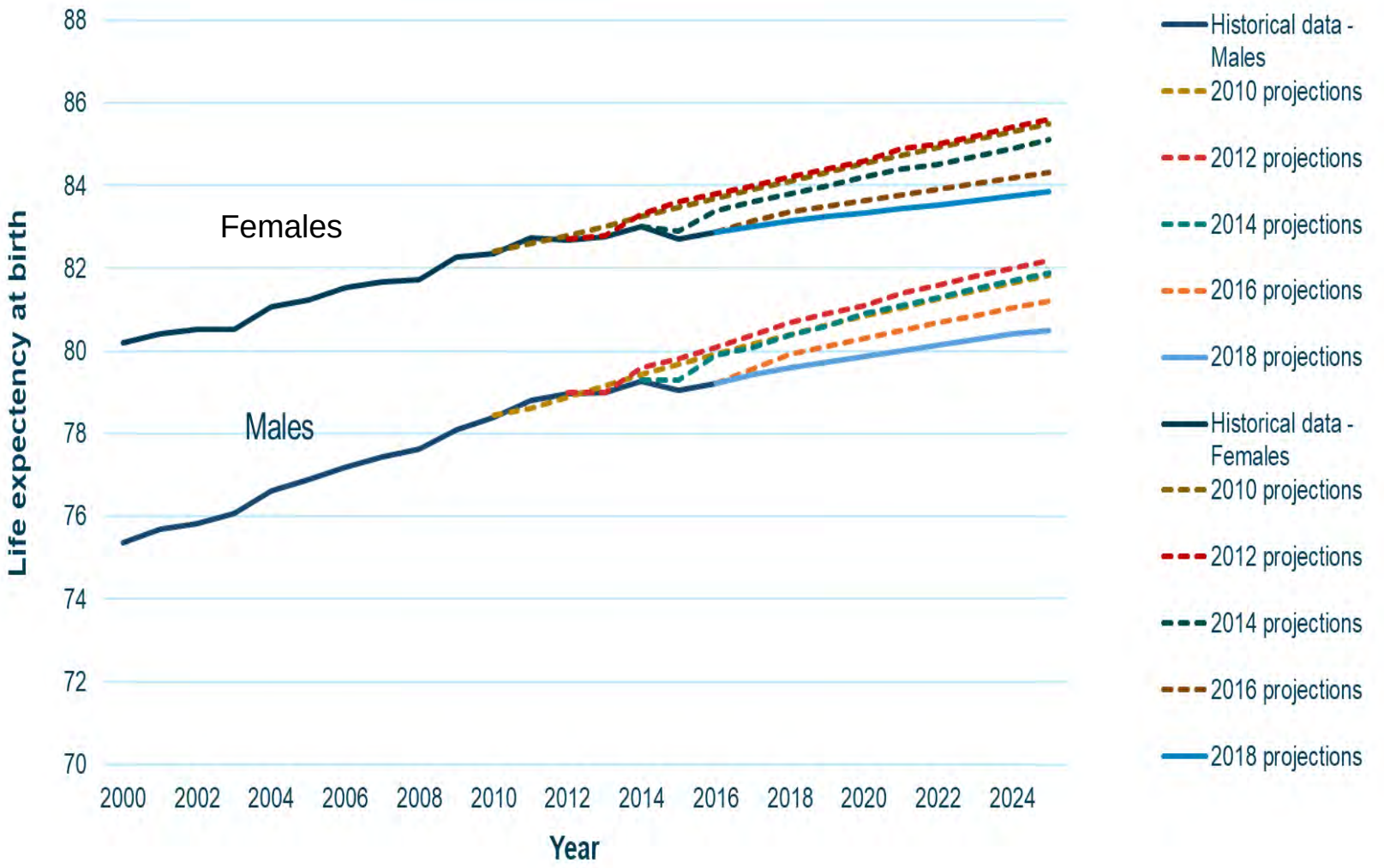
UK: ONS Principal period life expectancy at birth, projections from 2010 to 2018



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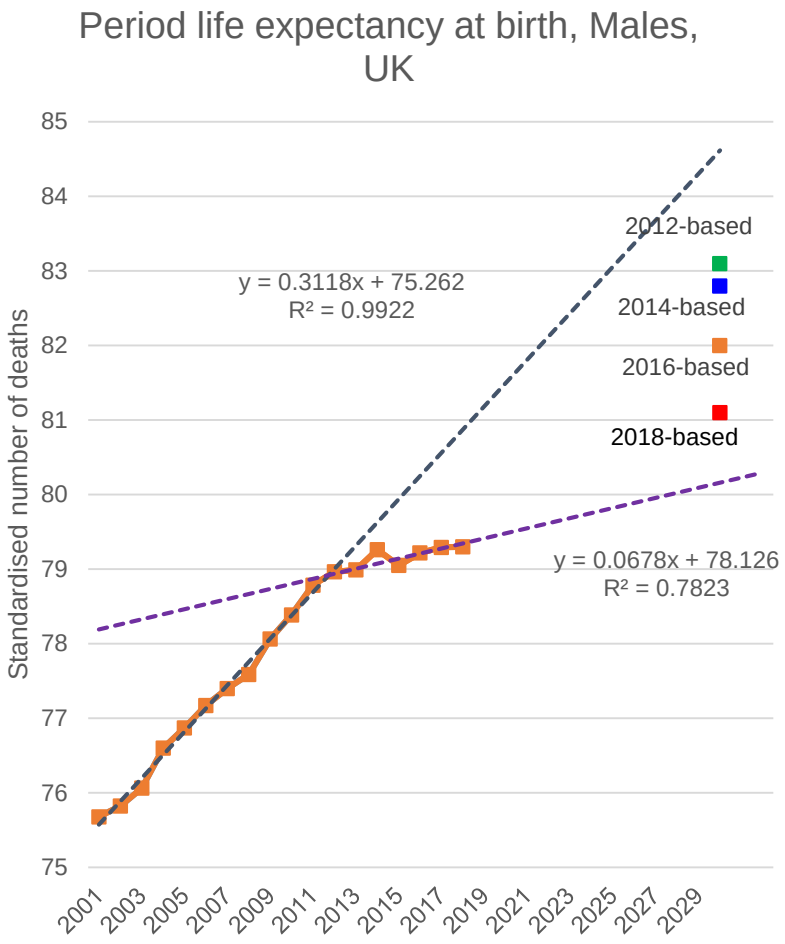
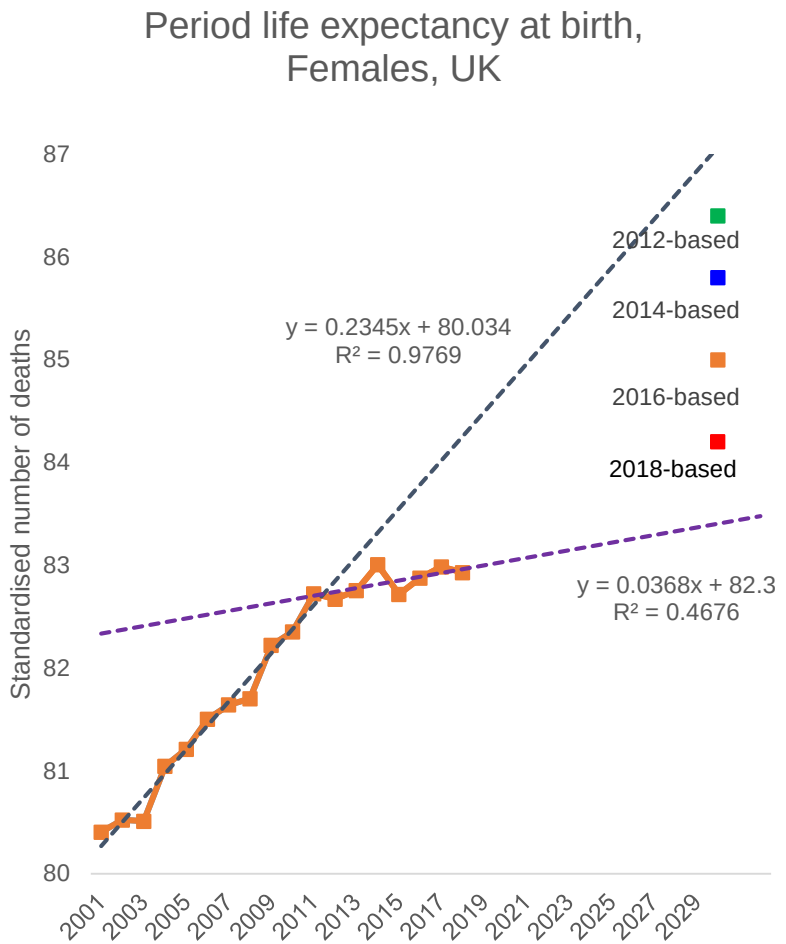
UK: Historical and projected period life expectancy at birth





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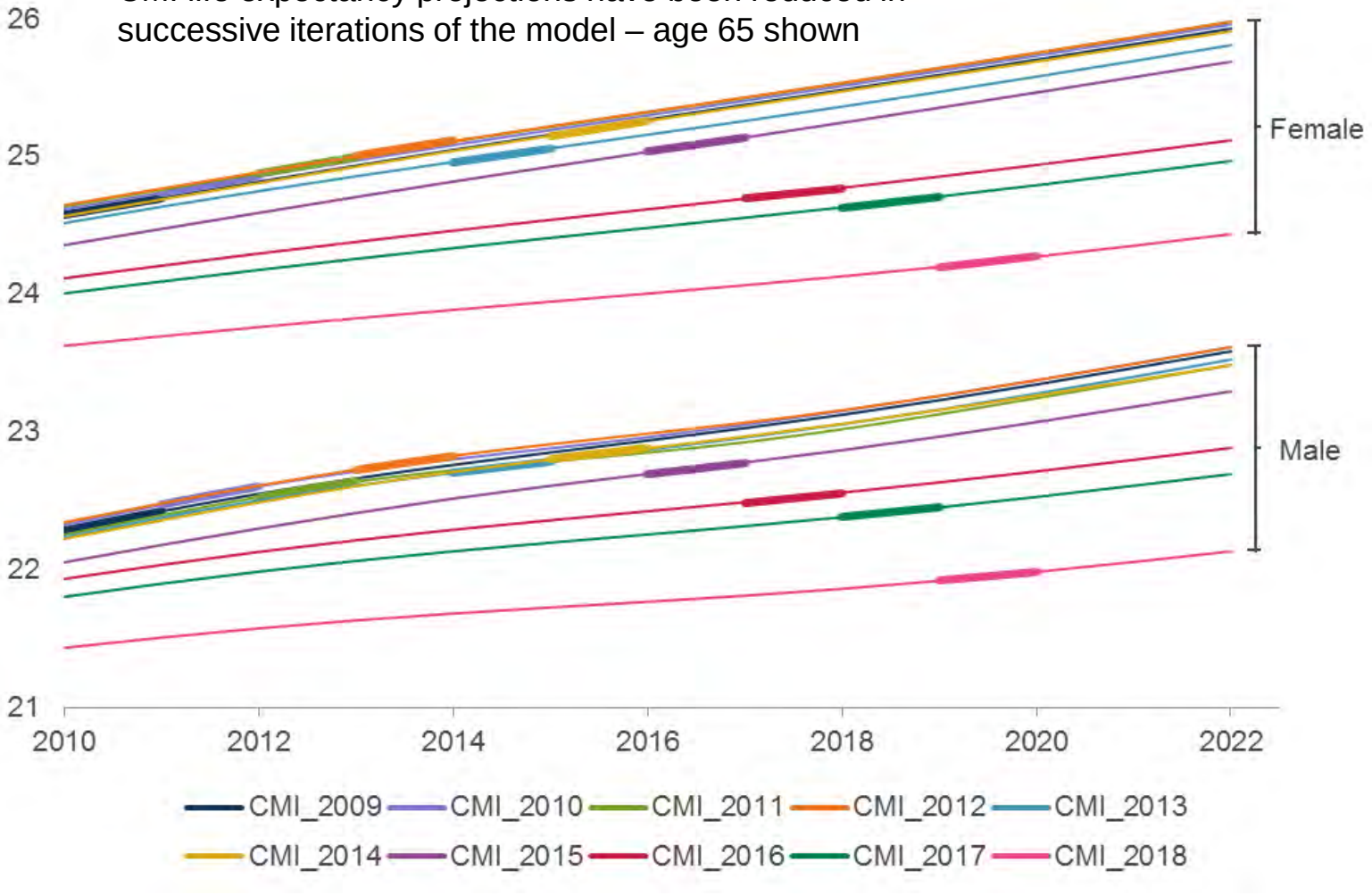
The CMI Model – Cohort life expectancy age 65

CMI life expectancy projections have been reduced in successive iterations of the model – age 65 shown



Source: CMI Working Paper 119

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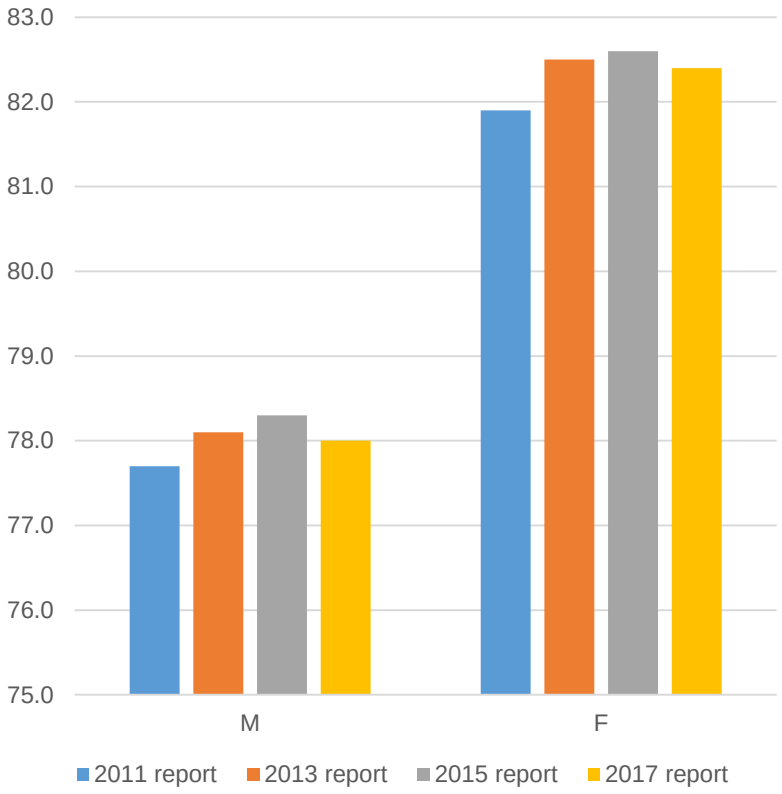
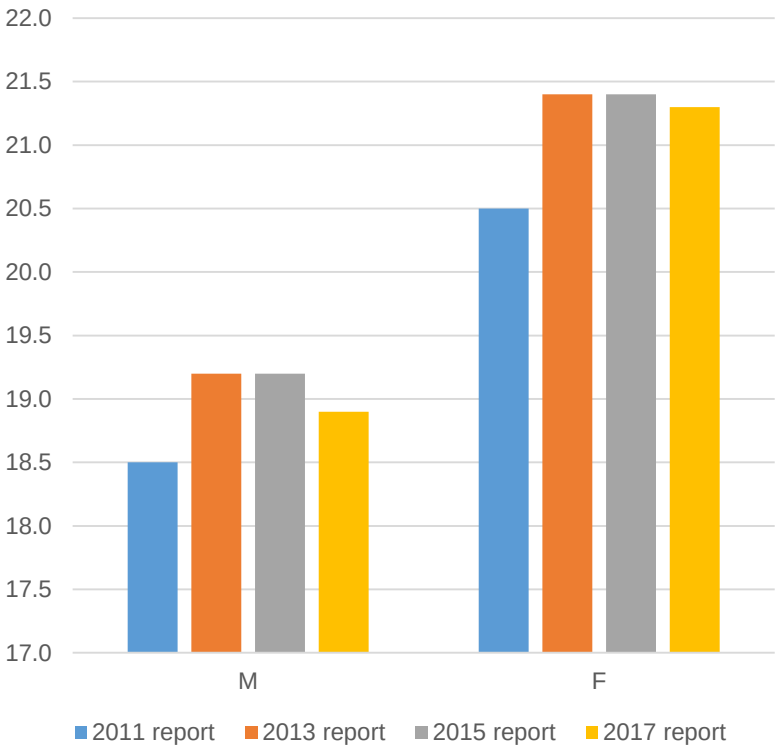
US OASDI: Successive projected period life expectancies in 2025

Projected period life expectancy at birth in 2025, OASDI Trustee Reports



Projected period life expectancy at age 65 in 2025, OASDI Trustee Reports



Source: USA Federal Old-age and Survivors insurance and federal Disability insurance trust funds (OASDI)

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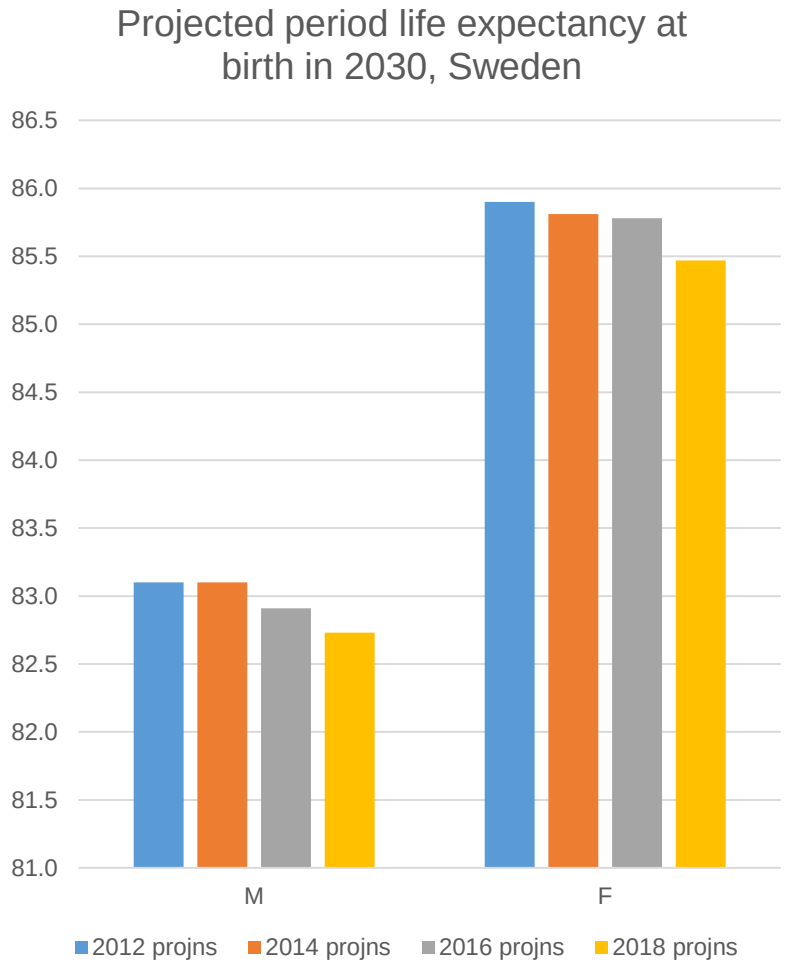
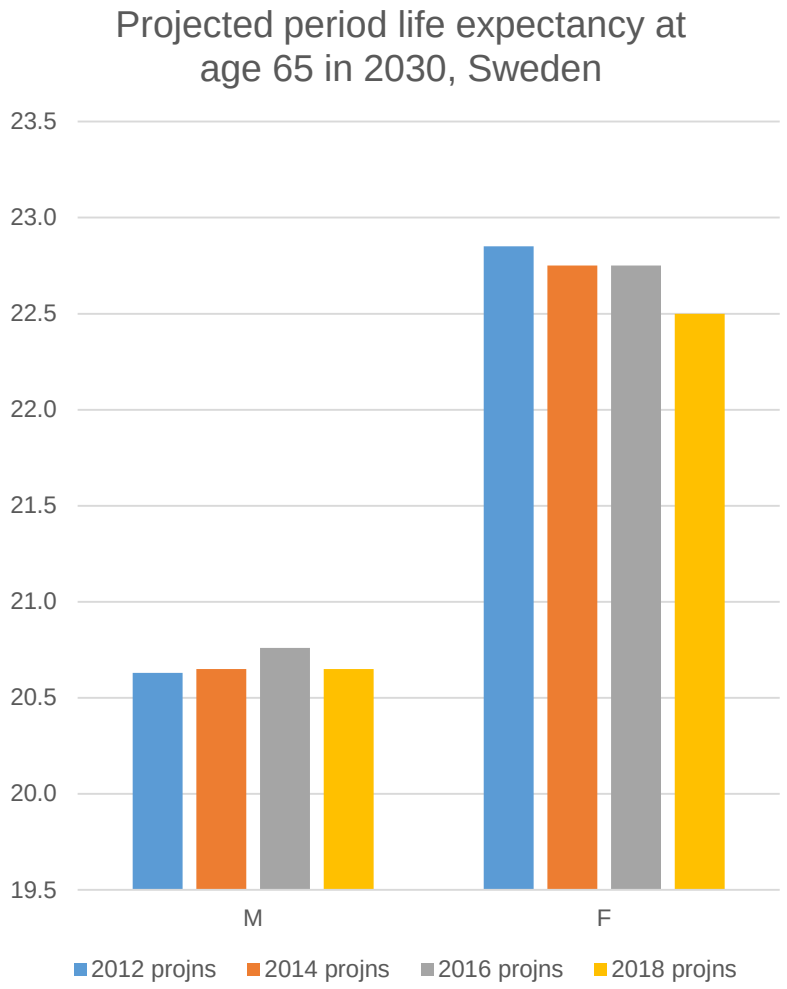
Sweden population: Projected period life expectancies in 2030





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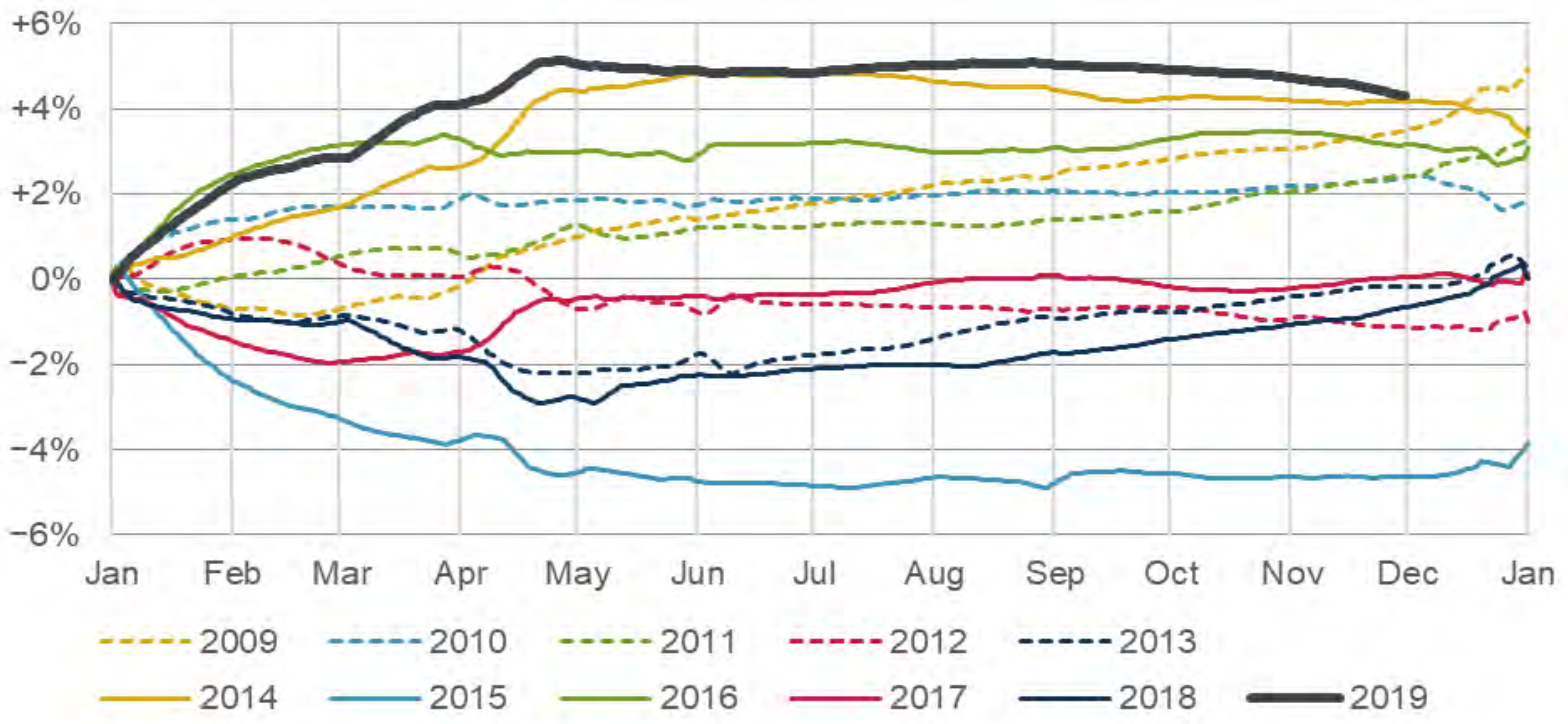
England & Wales: Cumulative annual standardised mortality improvement to November 2019



Mortality up to 29 November 2019 has been substantially lower than in the corresponding period in 2018. The cumulative mortality improvement reached a peak of +5.1% p.a. towards the end of April, before falling to +4.3% p.a. as at 29 November 2019. The cumulative improvement up to 29 November 2019 is slightly higher than in any of the previous ten years, although similar to 2014 and below the end-year value for 2009.

Source: CMI Working Paper 127

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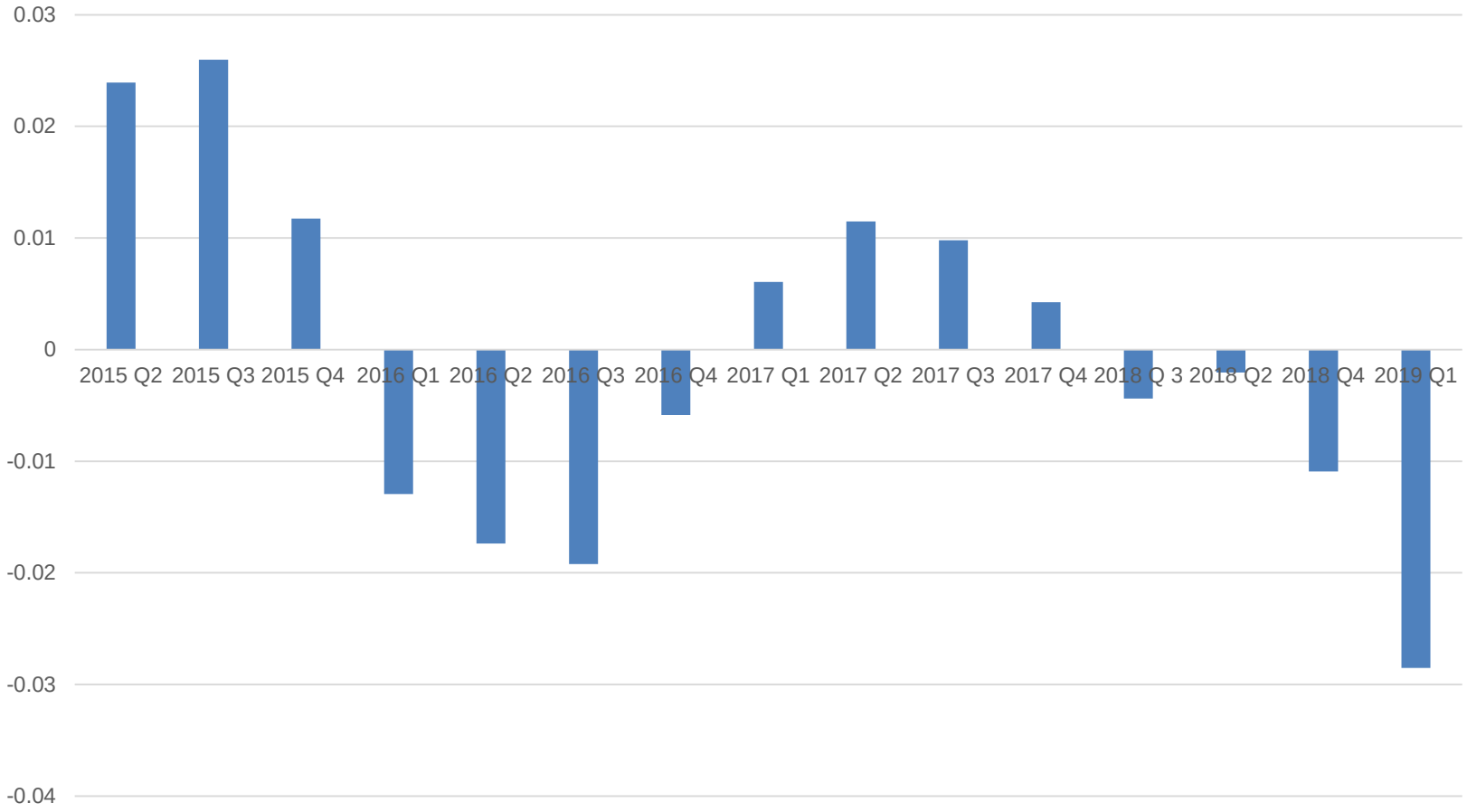
US Age-adjusted mortality rates (per 10,000) Annual change in rolling quarterly increases (-ve = improvement)



Source: Rapid Release CDC, from CDC website courtesy Sam Gutterman

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Conclusions

Longevity improvements have slowed down in many countries

Potential underlying causes include

- Excess winter mortality
- Cardiovascular/circulatory/stroke gains slackening
- Dementia and Alzheimer's
- External causes at younger ages (e.g. opioids)
- Lifestyle factors
- Socio-economic gaps in mortality widening
- Austerity

Impact on insured and pensioner populations differ:

> different subsets of the population

> exposure by "amounts" higher for higher socio-economic groups

Thank you

Any questions?

2020 Living to 100 Symposium

AL KLEIN, PRINCIPAL AND CONSULTING ACTUARY, MILLIMAN

Session 3B, Mortality Improvement – Discussion of Papers

January 13, 2020

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Review of:
“Does Migration Result in Mortality Improvement: A Case Study in Taiwan”

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Agenda

- Introduction
- Definitions
- Important issues
- Other considerations
- Suggestions
- Concluding thoughts

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Introduction

- While more work has been done on the impact of immigration on mortality, less has been done on the impact of migration on mortality
- I agree that the impact of migration on mortality is an important consideration in building models and making mortality projections, whether at the population level, for social insurance, or any other area where there is a need to understand the mortality of a segment of the population
- I think the paper gives us a good start and that the authors provided some good suggestions
- My focus will be on some possible insights into the findings of the authors and on some other considerations for the authors and anyone else who may be studying this topic
- The opinions expressed herein are solely mine and do not necessarily reflect the opinion of my employer, the SOA, or the Living to 100 organizing committee

Definitions

- Migration – Movement from one part of a country to another
- Immigration – Movement from one country to another
- Urban – Within a large city, town, etc.
- Rural – Living in a small community or no community a fair distance outside of a city, town, and suburban area
- Suburban – Living in a community that surrounds or is nearby a city, town, etc.

Important Issues in this study

- These issues may have impacted the results of this study and may or may not be relevant to other studies:
  - Eligible population
    - How large was the eligible population, i.e., those without other (labor, civil service, military servant, and farmer insurance) social pension programs?
    - How does the health/mortality of the eligible and ineligible groups compare?
  - Decreasing participation rate
    - Why are they happening?
    - Can they be reversed?

Important Issues in this study (cont'd)

- Issues (cont'd):
  - What is the right level of disability and income level for the government support and should this change over time?
  - At what point will the percentage of salary be sustainable as it cannot continue to grow indefinitely?
  - NPI should not be considered "substandard insurance"
  - Can the program become mandatory for all who do not have the other insurance programs?
    - Or, can the programs be merged?

Other Considerations

- These issues may provide additional insights into this study or may be considerations for the future (for this study or others):
  - Slow economic growth and income levels were flat
    - Not enough disposable income could lead to not joining or later dropping out
  - Could individuals opt out or are dropouts only allowed for later unemployment?
    - If economy worsens, typically leads to more unemployment
    - If unemployed, typically have less income and potentially less accessibility to care, thus likely higher mortality
    - Could some of those leaving the program be less healthy, and this be some or all of the explanation for the mortality improvement?

Other Considerations (cont'd)

- Issues (cont'd):
  - Publicity of the program was not addressed and could attract or detract from participation in certain populations
    - Were the benefits clearly communicated to all who were eligible?
    - Should a simple tool be put together to demonstrate the benefits, e.g., that you can not outlive the payments (assuming the program is sustainable)
  - Low interest rate environment is likely to stay and may even turn negative
    - What impact would negative interest rates have on participation, benefits, and the sustainability of the program?

Other Considerations (cont'd)

- Issues (cont'd):
  - Migration mortality rates may get worse over time due to the stress of getting acclimated to a different environment, culture, etc., whether moving from less healthy to healthy or vice versa
  - Migration mortality will be impacted by the following areas/issues:
    - Population density
    - More/less pollution
    - Better/worse access to healthcare
    - Similar/different cultures
    - Ability of the individual to acclimate mentally and physically to new situations/environments

Suggestions for improving this study

- If done again, please consider the following:
  - Split the vulnerable between low income levels and disability as there will likely be differences between these groups
  - Split the regions further into urban and rural within each region
  - When studying migration, split between those migrating to and from Northern Taiwan, as the results will likely be different

Concluding Thoughts

- It is difficult to come with the perfect study primarily because the desired data and measurements are not available
- My hope is that studies like this and the recommendations from it can help guide governments with program improvements, i.e., better program design/benefits, better participation rates and persistence, and sustainability of the programs

Sources of more information

- Nauman E, VanLandingham M, Anglewicz P, Patthavanit U, Punpuing S. Rural-to-Urban Migration and Changes in Health Among Young Adults in Thailand. *Demography*. 2015;52(1):233–257. doi:10.1007/s13524-014-0365-y https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4372468/
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Review of: “International and National Mortality Trends”

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Agenda

- My observations
- Approaches to mortality improvement projections
- Concluding thoughts

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My Observations

- It is interesting to see that so many countries had a slowing or deterioration in mortality in the same year, 2015 and that the reasons between countries was different
- Because of this sudden change, a number of the projection models, e.g., CMI, were changed to be able to better project this
- In the U.S., subsequent to 2015, there was also deterioration in 2016 and 2017, followed by improvement in 2018 and preliminarily in 2019, but what can we expect in the future?

My Observations (cont'd)

- Most of the discussion was regarding population mortality improvement (MI)
  - It would be interesting to see how these results compare for annuities, life insurance, public and private pension plans, and social security
  - There likely would be some different results
- I found the information on behaviors interesting and hopefully this can be expanded to other countries as I believe it can be used to better project future mortality improvement (MI) and/or deterioration

Approaches to Morality Improvement Projections

- I think we rely too much on the past numbers and drawing lines through these generally does not produce the right result long term, unless one is lucky
- Current approach by many is to extrapolate past for short term rate, set long term MI rate using expert opinion, and extrapolating between the two

Approaches to Morality Improvement Projections (cont'd)

- Another approach (that I like) is to:
  - Determine the drivers of the past results, whether these will continue into the future and at what rate
    - An example of this is whether the impact of the reduction in smoking prevalence has been partially or fully reflected in past MI rates
  - Determine what new impacts there will likely be short and longer term
    - Examples of this include immunotherapy and CRISPR on the positive side and the increasing levels of pollution and stress on the negative side

Concluding Thoughts

- I have personally been involved with some of this international research and hope that it continues and expands
- With a broadening of those involved and the learnings, hopefully some best practices can emerge

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