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Future British mortality prospects

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Introduction

‘The Roman emperor, Constantius, made a law forbidding “anyone to consult a soothsayer, a mathematician, or a forecaster …. May curiosity to foretell the future be silenced for ever.” However, even the death penalty was, it seems, insufficient to eradicate the condemned practice.’ (p. 309)

Hajnal, J. (1955). The prospects of population forecasts, *Journal of the American Statistical Association* 50:309–322.

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A meta projection approach: John Hajnal, 1955

(1) population projections in the future as in the past will often be fairly wide of the mark – as often as simple guesses would be

(2) nevertheless, the frequent preparation of projections will continue

(3) a projection can be useful even if its accuracy is low.

Hajnal, J. (1955). The prospects of population forecasts, *Journal of the American Statistical Association* 50:309–322.

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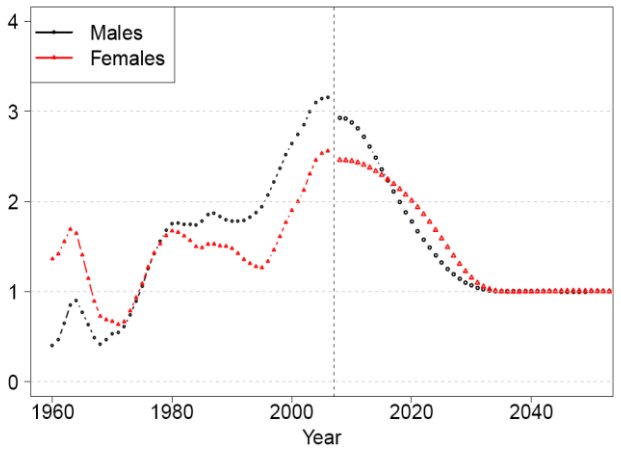
England & Wales standardised mortality rate annual improvement (%) 1960-2050



Author's calculations based on WHO European Standard smoothed(2006-based principal projection)

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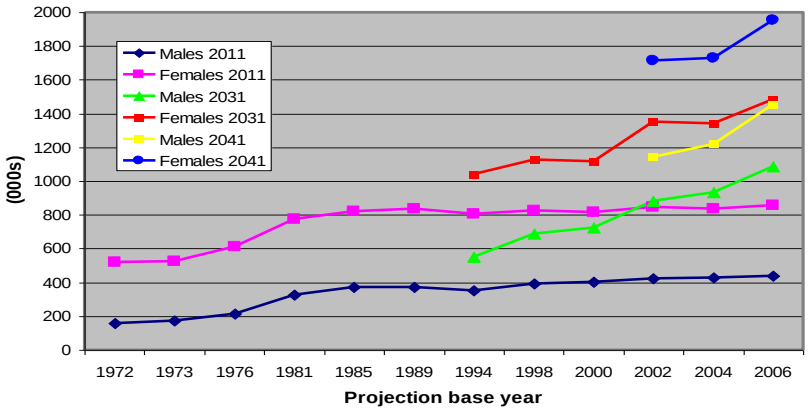
Projections of population 85 & over in 2011, 2031 and 2041, alternative projection base years, England & Wales



Source: author's calculations

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The *"Golden generations"*

"Those born during the period 1923–1940 (and centred around 1931) have exhibited greater rates of improvement over the last 25 years than those born on either side. There is currently no evidence that these differentials are declining. Similar cohort effects seen in other countries suggest that these differentials may persist well into the oldest ages."

(ONS PP2, 2008, p. 26)

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Three populations that have been noted as having particularly clear-cut cohort patterns

- England and Wales in the later 19th and early 20th century
- Japan early 20th century
- British cohorts born around 1930

The usual starting point

The analysis of cohort patterns has continued to receive attention following work around 1930 by Derrick (1927) and Kermack et al. (1934)

Kermack WO, McKendrick AG, McKinlay PL. Death-rates in Great Britain and Sweden. Some general regularities and their significance. *Lancet* 1934; March 31: 698-703.

Contour 'table' of indexed mortality rates (Table 2)

Derrick, V. P. A. (1927), "Observation on (1) error on age on the population statistics of England and Wales and (2) the changes of mortality indicated by the national records", Journal of the Institute of Actuaries, 58. (with discussion)

Table 2 England and Wales: relative mortalities. (The figures in th zero row refer to deaths under one year per 1000 births.)

AGE	1845	1855	1865	1875	1885	1895	1905	1915	1925
0	100	101	101	98	93	101	83	65	46
10	100	94	87	72	59	48	39	41	28
20	100	93	87	75	60	50	41	45	35
30	100	95	95	87	74	62	50	53	36
40	100	95	99	99	90	81	64	57	43
50	100	97	102	105	101	99	84	74	59
60	100	97	102	106	105	105	94	84	71
70	100	97	99	102	102	102	92	82	82
OVER 75	100	99	99	101	97	97	90	89	87

90

8

Kermack et al, 1934

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Their conclusion

"It will be seen that these contours show a remarkable tendency to follow the diagonals.

… the figures along a diagonal represent the rates experienced by a particular group (or generation) of individuals all born in a particular year-period

The general conclusion … would seem to be that … the relative mortality is approximately constant for each generation at all periods of life." (p. 679)

Kermack et al. (1934) Death-rates in Great Britain and Sweden. Some general regularities and their significance. Lancet 31:698-703.

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Other conclusions

"Cohort influences on mortality have been recognized since the pioneering work of Kermack, McKendrick, and McKinlay (1934). … the cohort patterns reflected genuine and persistent influences embedded in cohorts" (Preston and Yang 2006, p 638)

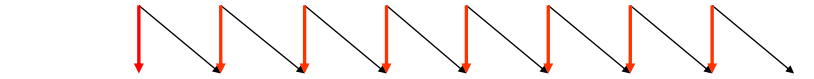
Preston, Samuel H. & Haidong Wang (2006) Sex Mortality Differences in the United States: The Role of Cohort Smoking Patterns, *Demography* 43(4):631-646

Some comments

- values below age 20 do not show such behaviour (i.e. the contour lines should appear vertical rather than diagonal at these ages in Table 2)
- above age 60, there is only one inconclusive observation for the post-1845 cohorts shown
- so no evidence for cohort patterns outside the age-range 20 to 60
- deaths between ages 20 and 60 accounted for only 20 per cent of the cohort's deaths among those born in the last decade of the Nineteenth century (about 30 per cent below age 20, and 50 per cent at ages 60 and over)

Period or cohort? (black arrow cohort; red arrow closest value)

	Period								
Age	1841-50	1851-60	1981-70	1871-80	1881-90	1891-1900	1901-1910	1911-1920	1921-30
0	100	101	101	98	93	101	83	65	46
5-15	100	94	87	72	59	48	39	41	28
15-25	100	93	87	75	60	50	41	45	35



Preston, Samuel H. & Haidong Wang (2006) Sex Mortality Differences in the United States: The Role of Cohort Smoking Patterns, *Demography* 43(4):631-646, Table 2

Some comments (contd)

- the baseline data used to index later mortality, namely mortality in the period 1841-50, refers to very different cohorts
- constant cohort ratios for those born in the period 1850 to 1890 can only be interpreted if mortality was essentially unchanged in the period prior to 1841

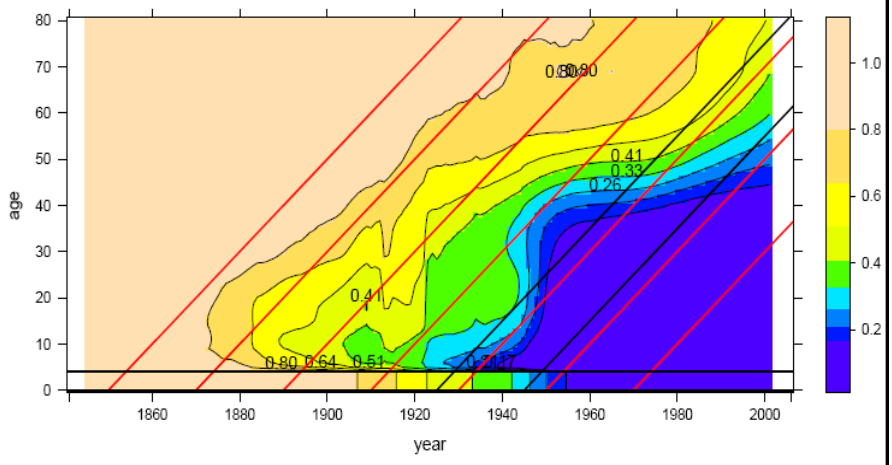
Some comments (contd)

- diagonal isoquants do not identify unambiguous cohort mortality patterns in situations of essentially monotonic improvements in mortality
- “when nonlinear terms for cohort and period are introduced along with a common linear drift term, the typical result across countries is that the linear drift term explains the great majority of variation in all-cause mortality” (Preston and Yang 2006, p 638)

Some comments (contd)

- the cohort pattern was identified clearly only for Britain but not for Sweden, a country with more accurate data over a more extended period
- even in the 1930s as their analysis was being published, it became apparent that the predictions of Derrick (1927) and Kermack et al (1934) failed to be confirmed

An updated Kermack et al analysis, England and Wales, Males, 1841-2006



Indexed q_x values on period 1841-50, double smoothed with 10-pt MA infant mortality shown as band at bottom of chart

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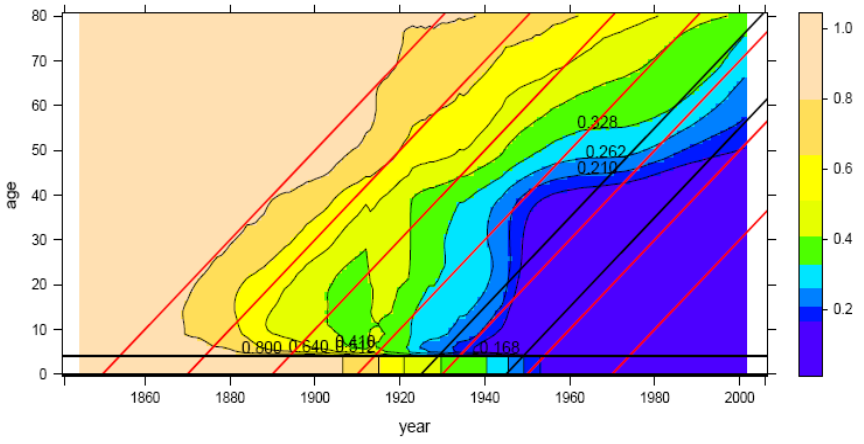
An updated Kermack et al analysis, England and Wales, Females, 1841-2006



Indexed q_x values on period 1841-50, double smoothed with 10-pt MA infant mortality shown as band at bottom of chart

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A plausible mechanism

"Human height becomes greater and growth takes place more rapidly, other things being equal, in proportion as the country is richer, comfort more general, houses, clothes and nourishment better and labour, fatigue and privation during infancy and youth less; in other words, the circumstances which accompany poverty delay the age at which complete stature is reached and stunt adult height." (René Villermé, 1829 quoted in Davey Smith & Kuh, 2001)

Davey Smith, George ,and Diana Kuh (2001) Commentary: William Ogilvy Kermack and the childhood origins of adult health and disease. International Journal of Epidemiology;30:696-703

Some comments (contd)

- the existence of the Nineteenth and early Twentieth century British patterns are interpreted as cohort effects based on a process of elimination
- what was observed was mortality improvement from the middle of the Nineteenth century starting first among young adults and then spreading to both older and younger ages

The Statistics Committee of the Royal Commission on Population

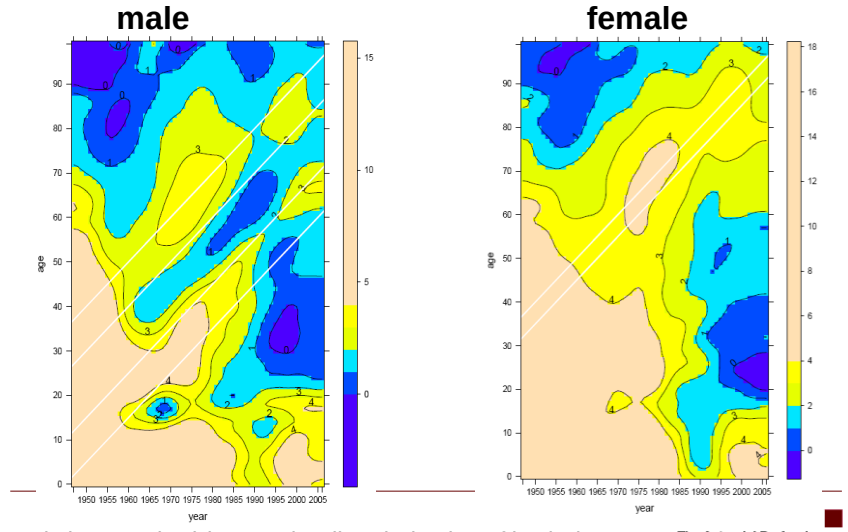
"We had on our Committee Mr Derrick, the great exponent of [the generational] theory, and we had on the other side Professor Kuczynski, who was the exponent of the year of observation theory, and the arguments were so furious at some of these meetings that I sometimes had considerable doubt whether the rate of mortality among the Committee might not be unduly high!" (quoted in Davey Smith & Kuh, 2001)

The case of Japan

- Japan has been identified as having particularly clear patterns, with an advantaged (or 'select') generations of both men and women born just after 1910 and another of men born in years 1935-45
- The cohort of women was identified as having persistent patterns (young ages not considered) (Willets 2004)

Willets, R. C. (2004), *The Cohort Effect: Insights and Explanations,* British Actuarial Journal, Vol. 10(4): 833-877

Estimated annual rate of age-specific mortality improvement (%), Japan



Analytic smoothed (spar=.7) spline derivative of log(qx)

Japanese female cohorts

- the high rates of improvement for the 1910 and surrounding female cohorts have not continued beyond 1995 when this cohort was in their early 80s
- with the mortality levels of the late 1990s, two thirds of Japanese women would still be alive at age 82

Japanese male cohorts

- high rates of improvement for the male cohorts born on either side of around 1925 may result from the especially poor experience of this intermediate group
- about 2 million Japanese men died in wars, mostly through disease and starvation, during 1937-45
- this group was uniquely disadvantaged by selection and scarring

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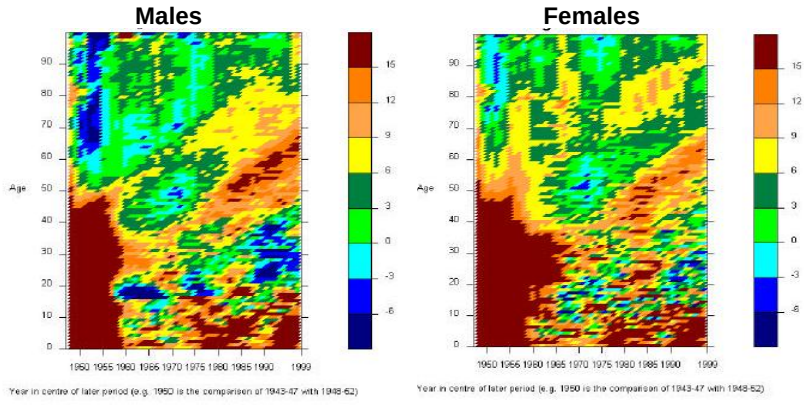
Percentage improvements in age specific mortality rates comparing 5 year averages England and Wales



National Statistics & GAD. National Statistics Quality Review Series Report No. 8: **National Population Projections: Review of Methodology for Projecting Mortality (2001),** (p50-1)

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Role in forecasting

The ‘golden cohort’ generations are currently dominating the old ages and raising the average rate of improvement.

As these cohorts age, their influence on overall mortality measures will diminish.

Hence, other things remaining equal, it might be expected that the overall rate of improvement would decline as these cohorts become very old.

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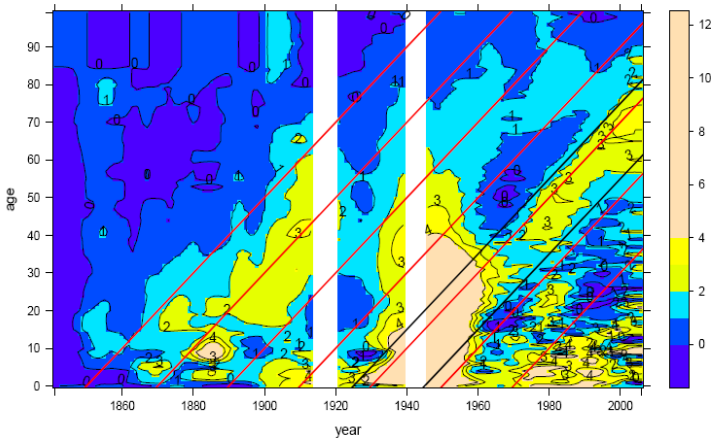
Estimated annual rate of age-specific mortality improvement (%), England and Wales, Females, 1841-2006



Analytic smoothed (spar=.7) spline derivative of log(qx) excluding 1914-20, 1940-45

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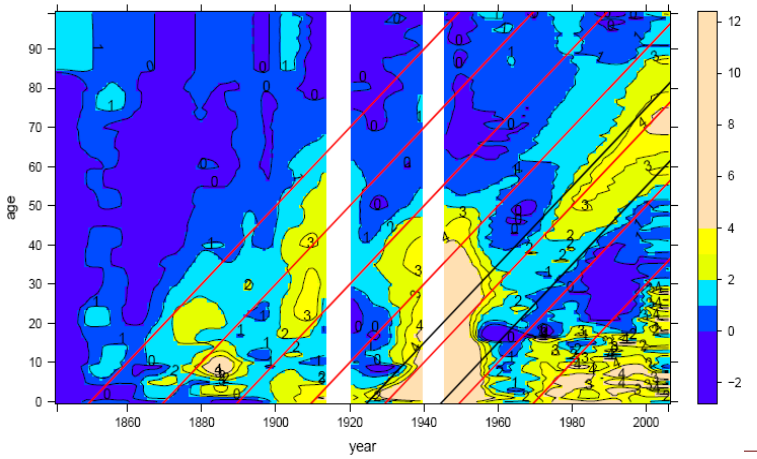
Estimated annual rate of age-specific mortality improvement (%), England and Wales, Males, 1841-2006



Analytic smoothed (spar=.7) spline derivative of log(qx) excluding 1914-20, 1940-45

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Hypothesised explanations for the *'Golden generations'* include:

- Differences in smoking patterns between generations
- Better diet and environmental conditions during and after the Second World War
- Differing birth rates, with those born in periods of low birth rate facing less competition for resources as they age
- Benefits from the introduction in the late 1940s of the Welfare State
- These generations have benefited from medical advances which have increasingly affected older people.

Karen Dunnell, 2008, Ageing and Mortality in the UK – National Statistician's Annual Article on the Population. Population Trends 134: 6-23, p. 19

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Main drivers of past mortality - and future also?

- Medical Advances (inc. progress in preventive medicine)
- Smoking trends: lung cancer rates for men in the UK have peaked
- Obesity: likely to lead to increased future morbidity, but unclear how mortality will be affected
- Infectious diseases inc. drug-resistant diseases
- Uncertainty at young ages: mortality rates in the 1980s and 1990s increased for young ages (due to AIDS, drug and alcohol abuse and violence)

Karen Dunnell, 2008, Ageing and Mortality in the UK – National Statistician's Annual Article on the Population. Population Trends 134: 6-23, p. 19

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A little less computation and a little more cogitation?

"as little forecasting as possible should be done, and … if a forecast .. is undertaken, it should involve less computation and more cogitation than has generally been applied. Forecasts should flow from analysis of the past. Anyone who has not bothered with analysis should not forecast. The labor spent in doing elaborate projections on a variety of assumptions by a ready-made technique would often be much better-employed in a study of the past." (p. 321)

Hajnal, J. (1955). The prospects of population forecasts, *Journal of the American Statistical Association* 50:309–322.

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Conclusions

- The existence of 'real' cohort effects that are (a) long-lasting and (b) important has not been clearly demonstrated (even in the most extreme conditions e.g. Dutch hunger Winter, Leningrad siege or Finland 1869 famine)
  - *More attention needed as to whether cohorts are "pseudo-cohorts"*
- Defensible causal explanations for macro-level cohort effects do not exist, unlike for micro-level studies
  - *The relationship of male and female patterns of the 'Golden generations' remains unclear (smoking may not be sufficient)*
- ***More multidisciplinary work (cogitation) is needed***

Thank you