

Trends in life expectancy and age-specific mortality in England and Wales, 1970–2016, in comparison with a set of 22 high-income countries: an analysis of vital statistics data

David A Leon, Dmitry A Jdanov, Vladimir M Shkolnikov



Summary

Background Since 2010, the rate of improvement in life expectancy in the UK has slowed. We aimed to put this trend in the context of changes over the long term and in relation to a group of other high-income countries.

Methods We compared sex-specific trends in life expectancy since 1970 and age-specific mortality in England and Wales with median values for 22 high-income countries (in western Europe, Australia, Canada, New Zealand, Japan, and the USA). We used annual mortality data (1970–2016) from the Human Mortality Database.

Findings Until 2011–16, male life expectancy in England and Wales followed the median life expectancy of the comparator group. By contrast, female life expectancy was below the median and is among the lowest of the countries considered. In 2011–16, the rate of improvement in life expectancy slowed sharply for both sexes in England and Wales, and slowed more moderately in the comparator group because of negative trends in all adult age groups. This deceleration resulted in a widening gap between England and Wales and the comparators from 2011 onwards. Since the mid-2000s, for the first time, mortality rates in England and Wales among people aged 25–50 years were appreciably higher than in the comparator group.

Interpretation Although many countries have seen slower increases in life expectancy since 2011, trends in England and Wales are among the worst. The poor performance of female life expectancy over the long-term is in part driven by the relative timing of the smoking epidemic across countries. The previously overlooked higher mortality among young working-age adults in England and Wales relative to other countries deserves urgent attention.

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Introduction

For more than half a century, western European and other high-income countries have seen steady rises in life expectancy at birth.¹ The reasons for this improvement include steps to control risk factors such as smoking and the adoption of increasingly effective treatments and screening programmes.² However, fluctuations in the pace of mortality reduction are not uncommon and have been found in many high-income countries.^{3–5}

Typically, a year in which life expectancy falls is followed by a rebound. An analysis reported declines in life expectancy (2014–15) in 11 of 18 high-income countries examined.⁶ Most of these showed a larger than average improvement in the subsequent period (2015–16). However, the UK and the USA were exceptions in that neither showed the expected recovery. Indeed, since 2010 the UK and each of its constituent countries⁷ have had smaller increases in life expectancy than have been previously recorded,⁵ with no change at all between 2016 and 2017.⁸

This plateauing of life expectancy in the UK has received attention among researchers and public health

specialists. A particular focus has been on old-age mortality and its relationship to the policy of fiscal austerity pursued by UK governments since 2010.^{9,10} However, less attention has been given to the adverse mortality trends at younger ages, even though several analyses have shown increases since 2010 in all-cause mortality in adults younger than 50 years in England¹¹ and other parts of the UK.⁷

Several reports have shown that the UK is not alone in showing reductions in the rate of increase of life expectancy.^{5,12} A 2019 report by the Organisation for Economic Co-operation and Development¹² showed that life expectancy improvements in most EU countries over the period 2011–16 were slower than in the preceding 5 years, 2006–11, although the deceleration in the UK was the largest. Such geographical and temporal contextualisation sheds new light on the challenges faced by the UK and helps to identify priority areas for intervention.^{12–14}

We aimed to examine how life expectancy and mortality rates in England and Wales have evolved since 1970

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Department of
Non-communicable Disease
Epidemiology, London School
of Hygiene & Tropical Medicine,
London, UK

(Prof D A Leon PhD);
Department of Community
Medicine, UiT Arctic University
of Norway, Tromsø, Norway
(Prof D A Leon); Laboratory of
Demographic Data, Max Planck
Institute for Demographic
Research, Rostock, Germany
(D A Jdanov PhD,
V M Shkolnikov PhD);
and International Laboratory
for Population and Health,
Higher School of Economics,
Moscow, Russia
(D A Jdanov, V M Shkolnikov)

Correspondence to:
Prof David A Leon, Department
of Non-communicable Disease
Epidemiology, London School of
Hygiene & Tropical Medicine,
London WC1E 7HT, UK
david.leon@lshtm.ac.uk

Research in context

Evidence before this study

Since 2011, the long-term trend in the increase of life expectancy in England and the rest of the UK has faltered. Previous analyses of this issue have tended to emphasise the effect on old age mortality of the austerity policy pursued by the UK Government over the past decade. The UK is not alone in showing some degree of deacceleration in life expectancy progression in the most recent period. We searched PubMed, without time restrictions, using the terms (“England” or “United Kingdom”) and (“life expectancy”) and (“trends”) or (“stalling” or “decline”). Given our objectives, we focused primarily, but not exclusively, on material published between 2010 and 2019.

Added value of this study

We placed these trends in the context of what has happened in a group of other high-income countries over the longer term since 1970. Until 2010, male life expectancy in England and Wales was unremarkable and tracked the median value for a set of 22 comparator countries. By contrast, female life expectancy has not progressed as well as it has in other countries since the

mid-1970s, largely because of the relative timing of the smoking epidemic. However, for both sexes since 2011, the deficit in life expectancy has grown between England and Wales and the median of the comparator countries, which is unlikely to be due to chance. This deficit was due to divergence in mortality among working-age and older adults between England and Wales and the other countries. A new phenomenon has emerged since the mid-2000s whereby mortality in young and middle-aged men and women is now appreciably higher than in the 22-country comparison group.

Implications of all the available evidence

High-income countries as a group have struggled to maintain the rates of life expectancy improvement. The UK has in the most recent period shown particularly small improvements. However, whether this performance will persist into the future is unclear. Particular attention must be paid to understanding why mortality rates in young and middle-aged adults in England and Wales are diverging from those of their peers elsewhere.

relative to a set of other high-income countries. We paid particular attention to differences between men and women and distinctive age patterns.

Methods

Populations, timepoints, and sources

We used annual mortality data (1970–2016) from the Human Mortality Database (HMD),¹⁵ which applies comprehensive and uniform methods to ensure high-quality mortality estimates at all ages that are comparable across time and between countries. Of the available HMD countries, we selected those that we considered as high-income peers of England and Wales. These countries have low mortality and had undergone substantial and steady improvements in life expectancy over the past 50 years or more, and had complete annual time series data available for 1970–2016. Our comparator group of countries comprised 15 countries from western Europe, plus Australia, Canada, New Zealand, Japan, and the USA (figure 1). We also included Scotland as a separate population because of the country's higher mortality rates than in England and Wales,¹⁶ making a total of 22 countries.

Statistical analysis and visualisation

We used median life expectancy and mortality rates for all 22 comparator countries to express the central tendency for this group. The median is less sensitive than mean values to random fluctuations of life expectancy and mortality that occur in small countries (eg, Iceland). For each year, the median death rate at every age was calculated as the median of death rates across all countries at the same age. In the same way, we

computed the upper and the lower quintile death rates for every age. These median and quantile age-specific death rates were then used to calculate life tables and life expectancy at birth for the median, the upper, and the lower 20% levels.

To visualise the long-term evolution of differences in life expectancy in England and Wales relative to the other countries between 1970 and 2016, we plotted the annual life expectancy for England and Wales and each of the other 22 countries for men and women separately. These life expectancies were then overlaid with the annual median and the top and bottom quintiles (upper 20th and lower 20th percentiles) for the 22 comparator countries. For every year from 1970 to 2016, we calculated the ratio of the total mortality rates in each 1-year age group in England and Wales to the median of the comparator countries.

Finally, focusing on the trends that have occurred in the most recent years, we separated the differences in life expectancy between England and Wales and the 22-country median for the periods 2001–06, 2006–11, and 2011–16 into two components. The first component shows the absolute contribution in years of life expectancy of differences in trends over each 5-year period broken down by broad age groups. The second component isolates the contribution of the differences between England and Wales and the 22-country median at the end of each period that was attributable to differences seen at the start of the interval, using the method of contour decomposition of differences between life expectancies.¹⁷ For example, for a life expectancy difference between two populations of 1.5 years in 2016, the contour decomposition method might show that 0.8 of the

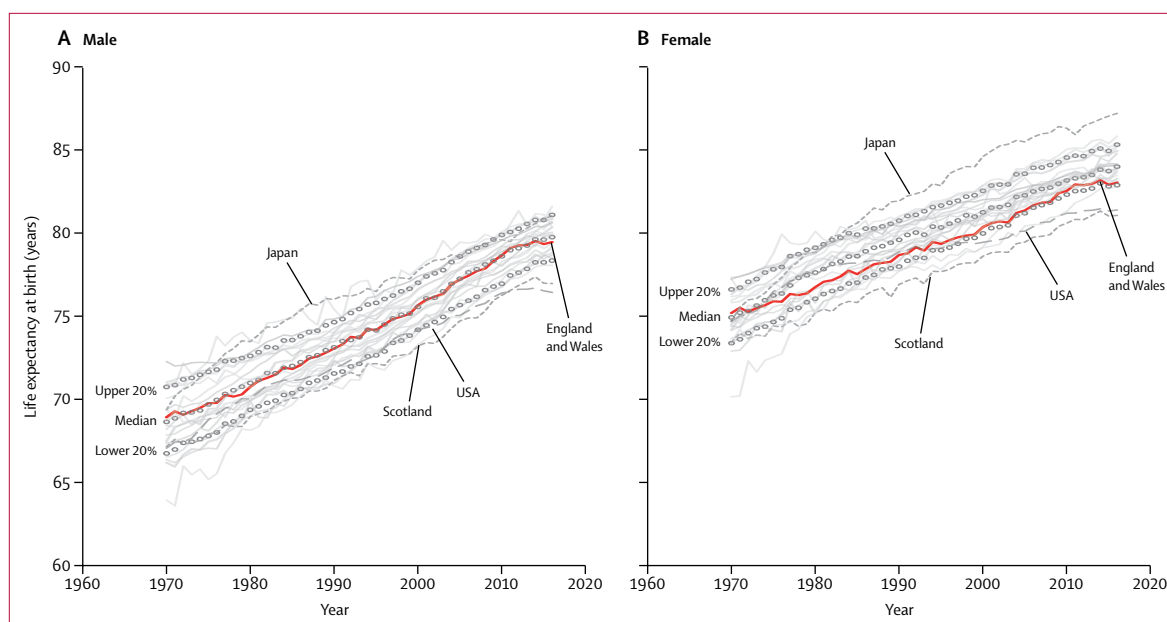


Figure 1: Life expectancy at birth in 23 high-income countries and regions, plus the (cross-country) median life expectancy and the lower and the upper median life expectancy quintiles for the comparator group of 22 countries, 1970–2016

Countries included are Australia, Austria, Belgium, Canada, Denmark, England and Wales, Finland, France, Germany, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Scotland, Spain, Sweden, Switzerland, and the USA. Median and upper and lower quintile values are shown as open circles. A spreadsheet of the data on which this figure is based are provided in the appendix (p 4).

1·5 years are due to the initial mortality difference in 2011, and 0·7 years are due to a steeper mortality decrease in one population relative to that in the other. These 0·7 years can be further split by age so that 0·3 years are produced by mortality trends in people younger than 65 years, and 0·4 years could be caused by mortality trends in people older than 65 years. Further details about this method are provided in the appendix (pp 1–2).

Role of the funding source

This study was done without specific funding. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

Figure 1 shows the trends in life expectancy at birth from 1970 to 2016 for men and women for England and Wales and the 22 comparator countries. Male life expectancy at birth in England and Wales followed the median almost exactly apart from in the late 1970s and in 2011–16, and occupied between the 10th and 12th rank positions up until the end of the 2000s, from which point it was between the 11th and 14th positions.

Female life expectancy in England and Wales was at the median level of the 22 comparator countries in 1970. However, from that point until the mid-1980s, female life expectancy, relative to the median, deteriorated considerably, with a fall in rank position from 9th to 18th. Since then, female life expectancy in England and Wales

has followed the bottom quintile of the distribution, and in the years 2014–16 was ranked 20th.

The average annual increases in life expectancy in consecutive 5-year periods starting in 1971–76 to 2011–16 for England and Wales and the 22-country median are shown in table 1. 2011–16 showed the smallest increase for the 22-country median and England and Wales. The life expectancy increase in England and Wales was particularly small. This finding contrasts with the rate of improvement in the previous period (2006–11) that was the largest for England and Wales for both sexes (table 1).

To assess whether the divergence in the rate of improvement between England and Wales and the median mortality based on the 22 comparator countries was larger than might be expected by chance given the year-by-year fluctuations, we regressed the annual difference between the two life expectancies by year over the period 1996–2011. We projected this trend forward to 2016 with its 95% CI. For 2015 and 2016, for both sexes the observed difference between England and Wales and the 22-country median fell below the lower 95% CI, suggesting that the larger slowdown in England and Wales compared with other countries is unlikely to be due to chance (appendix pp 3–4).

Figure 2 shows the mortality rates in each 1-year age group in England and Wales as a ratio to the corresponding median mortality rates for the 22 comparator countries. We found a diagonal pattern of higher male mortality at age 50 years and older in England and Wales relative to the 22-country median. We found a

See Online for appendix

similar, even more pronounced, diagonal pattern for women, although the pattern is displaced down and to the right compared to men (figure 2). The diagonal dotted

line indicates the birth cohort of 1900 for men and 1925 for women, which were the cohorts that smoked most in the UK, as supported by the fact that men and women born around these dates have had the highest lung cancer mortality of any birth cohorts.¹⁸

We found a simultaneous emergence in men and women from the mid-2000s of excess mortality among those aged 25–50 years in England and Wales relative to the 22-country median, as delineated by a continuous white line (figure 2). This finding is particularly striking for men because in the preceding years up to the mid-1990s, mortality was lower than in the 22-country median in men younger than 40 years (figure 2).

The effect of the negative trend in working-age mortality in England and Wales on differences in life expectancy relative to the 22-country median is shown in table 2. In 2016, the life expectancy disadvantage of England and Wales was -0.34 years for men and -1.00 years for women (table 2). In 2011, male life expectancy in England and Wales was 0.25 years higher than the comparator

	Male		Female	
	England and Wales	22-country median	England and Wales	22-country median
1971-76	0.10	0.21	0.07	0.26
1976-81	0.27	0.32	0.24	0.27
1981-86	0.19	0.22	0.15	0.20
1986-91	0.25	0.21	0.19	0.15
1991-96	0.24	0.23	0.16	0.16
1996-2001	0.30	0.31	0.20	0.21
2001-06	0.29	0.30	0.22	0.21
2006-11	0.33	0.31	0.25	0.14
2011-16	0.07	0.18	0.02	0.13

Table 1: Mean annual change (years) in life expectancy at birth for England and Wales and the median of 22 countries by sex, 1971–2016

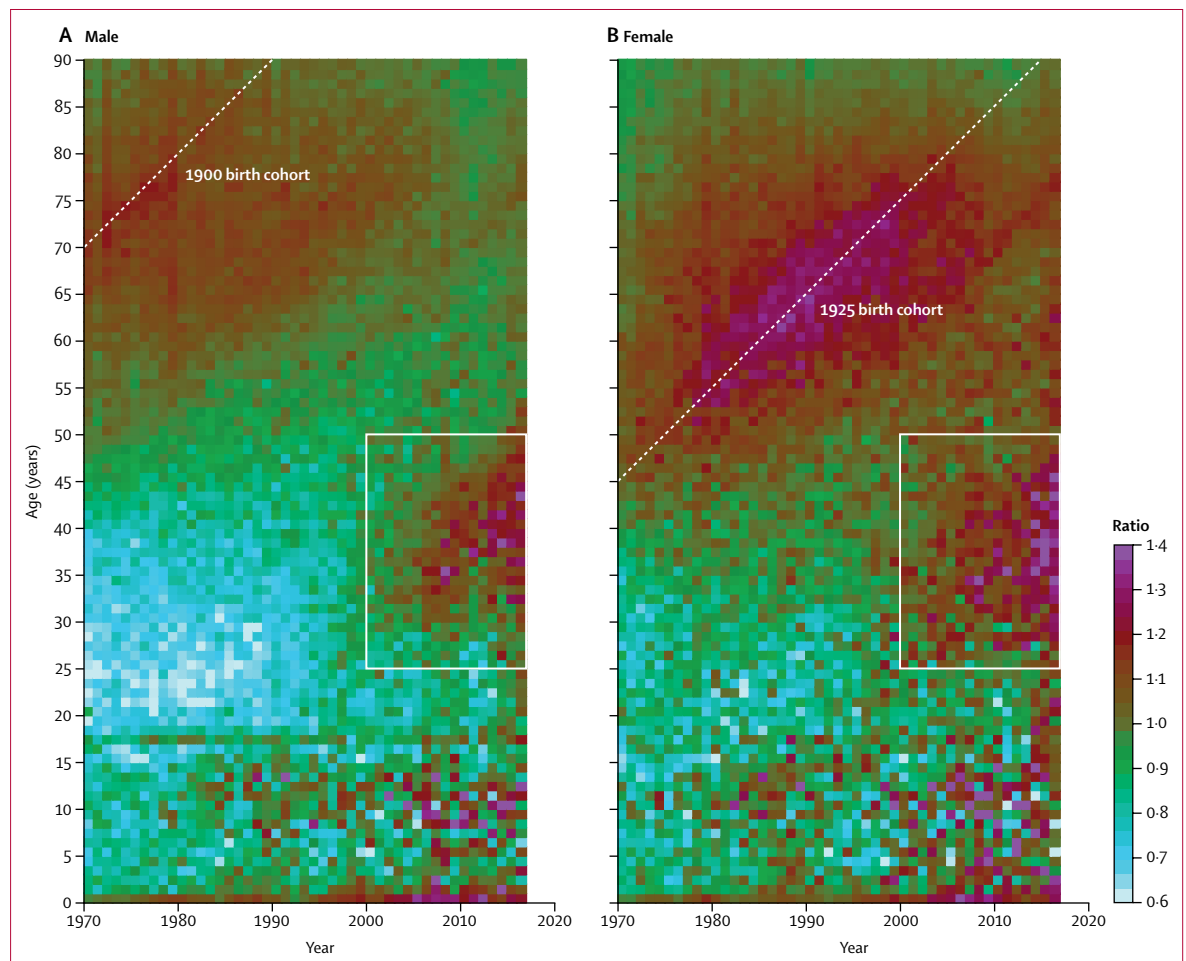


Figure 2: Mortality rate ratios in England and Wales relative to the median for 22 comparator countries by age, year, and sex
 Figure shows the ratio of the total mortality rates in each 1-year age group in England and Wales to the median of the comparator countries. The white dashed lines correspond to the 1900 male birth cohort and the 1925 female birth cohort. The white continuous lines delineate the area of emerging mortality excess in England and Wales relative to the 22-country median.

median, whereas for women there was a deficit of -0.41 years (table 2). The results of the contour decomposition (table 3) show the age-specific contribution of trends to the changes in life expectancy in each period. In the period 2011–16, the overall contribution of adverse trends was the same in both sexes (-0.60 years). All age groups, except boys aged 0–14 years, contributed to this negative trend. Adverse contributions at working ages (15–64 years) were slightly larger for men (-0.34 years) than for women (-0.25 years). Trends in people aged 65 years and older made similar sized contributions to these younger ages, and were similar for men (-0.29 years) and women (-0.33 years), although for women the contribution in those aged 80 years or older was particularly notable (-0.28 years).

Table 3 shows that the negative trend component seen in all adult age groups for 2011–16 was preceded in 2006–11 by positive trends in every age group except those aged 35–49 years. This finding is similar to that with respect to overall trends in life expectancy in the two most recent 5-year periods (table 1).

To check the robustness of our findings we repeated all analyses using means for the comparator countries rather than median values. These analyses were done in an equivalent way by taking the mean rather than the median and upper and lower fifths of age-specific mortality rates in each year for the 22 comparator countries. The substantive findings were not altered. We present figures and tables based on the estimated 22-country means rather than medians in the appendix (pp 5–8).

Discussion

Our analyses have uncovered several important and overlooked aspects of trends in life expectancy in England and Wales relative to those of our comparison group of 22 high-income countries. Firstly, throughout most of the period since 1970, male life expectancy in England and Wales followed the median central tendency of the comparator group. By contrast, since the mid-1970s, female life expectancy in England and Wales has been lower than in most other countries. Secondly, focusing on the past decade, a general slowdown in life expectancy improvement has occurred across many countries. However, during the period 2011–16, the slowdown was steeper in England and Wales than in many other countries, driven by diverging mortality rates at every adult age. Thirdly, and most surprisingly, since the mid-2000s, a new and worrying pattern has emerged of higher mortality rates among men and women aged 25–50 years in England and Wales compared with other countries.

To our knowledge, our analyses are the first to show that whereas male life expectancy in England and Wales between 1970 and 2010 was unexceptional, following almost exactly the median of the 22 countries analysed, female life expectancy in England and Wales compared poorly with other countries from the mid-1970s onwards.

	Male				Female			
	2001	2006	2011	2016	2001	2006	2011	2016
England and Wales	75.95	77.38	79.04	79.40	80.58	81.66	82.91	83.02
22-country median	75.97	77.61	78.79	79.74	81.52	82.52	83.32	84.03
Difference in life expectancy (years)	-0.02	-0.23	0.25	-0.34	-0.94	-0.86	-0.41	-1.00

Table 2: Comparison of life expectancy at birth (years) in England and Wales and median for 22 comparator countries in selected years, 2001–16

Age group (years)	Male			Female		
	2001–06	2006–11	2011–16	2001–06	2006–11	2011–16
0–14	-0.09	0.02	0.04	-0.08	0.08	-0.02
15–34	-0.11	0.05	-0.11	-0.01	0.02	-0.05
35–49	-0.13	-0.05	-0.09	-0.03	-0.02	-0.08
50–64	-0.01	0.07	-0.14	0.10	0.03	-0.12
65–79	0.10	0.19	-0.15	0.13	0.23	-0.05
≥ 80	0.04	0.29	-0.14	0.02	0.16	-0.28
All ages	-0.19	0.50	-0.60	0.13	0.50	-0.60
Component of life expectancy differences due to differences in initial year of period	-0.04	-0.25	0.26	-0.99	-0.90	-0.40

Table 3: Contribution of trends by age group and initial values to differences between life expectancy in England and Wales and the median for 22 countries for selected 5-year periods, 2001–16

This finding is despite the fact that since the mid-1990s, the gap in female life expectancy between England and Wales and the 22-country median narrowed in absolute terms until 2011.

A comprehensive analysis of factors that are likely to explain the long-term trajectory in life expectancy of England and Wales relative to the comparator group of countries was beyond the scope of this study. Ideally, we would have looked at comparable and comprehensive data for all the countries to examine long-term trends in many factors such as smoking, diet, exercise, obesity, alcohol, and the performance of the health-care systems. However, such data were available for only a small proportion of the countries we considered.

Our results suggest that smoking is likely to be one of the explanations for the long-term, relatively poor increase in female life expectancy in England and Wales from the early 1970s onwards. The UK was in the vanguard of the cigarette epidemic for men and women,^{19,20} although consistent with the diffusion model of smoking dynamics in the population, women started later than men.²¹ Indirect estimates of the contribution of smoking to total mortality by country in 1955, 1980, and 2009, support our contention that this factor is important for explaining the position of England and Wales (and Scotland) over the long term.²²

For women, from the early 1970s, England and Wales showed increasingly divergent mortality rates compared with the 22-country median, as shown by the diagonal

pattern centred on women born around 1925, who smoked more than other UK cohorts did before or subsequently (figure 2).^{18,23,24} We contend that this pattern exists because the UK was among the leaders of the global smoking epidemic. Many women in the UK took up smoking earlier in the 20th century and smoked more heavily than did women in most other countries. Smoking probably has less influence in explaining the relative mortality patterns of men in England and Wales in the period that we analysed. Although the birth cohort differences in how various countries took up smoking are also evident for men in figure 2, these differences are not as intense as for women, with the peak of the mortality effects of the early UK male smoking epidemic having already passed by the 1970s.

One of our most striking findings is that between 1970 and the mid-1990s, men younger than 45 years had persistently lower mortality than the 22-country median. A similar but less pronounced relative advantage is apparent in young adult women until the 1990s. This finding is partly explained by the UK having had particularly low mortality rates from external causes compared with other countries.²⁵ According to the Health for All database,²⁶ between the 1970s and the 1990s, the age-standardised death rates for external causes of injury, poisoning, and violence among people younger than 65 years were 30–35% lower than the average of the 15 members of the EU in May 2004 (EU15), before the accession of eastern European states. However, between 2001 and 2009, this advantage gradually disappeared, with rates in the UK going from being 28% to 18% lower. In the 2010s, this advantage was almost eliminated, being only 1% lower than that of the EU15 average by 2015.²⁶

The 23 countries in this study include many with some of the highest life expectancies in the world. In these countries, progress in female life expectancy is slower than for male life expectancy because it is increasing dependent upon overcoming the major challenge of reducing mortality at old and very old age, with diminished scope for reductions at younger ages, where much has already been achieved.²⁷

Our analyses confirm earlier observations⁹ of a plateauing of life expectancy in England and Wales in the period 2011–16. However, as others have found,^{5,12} we also showed that the rate of progress has declined for many other countries in the same period, albeit less dramatically. Our analysis has gone further than those in previous work in showing that since 2011, life expectancy has progressively diverged in England and Wales compared with other high-income countries as a group, and that this finding is unlikely to be due to chance. The low rate of improvement in 2011–16 in England and Wales was preceded by a 5-year interval (2006–11) with the largest annual improvements for England and Wales throughout the entire period covered by this study for both sexes. Moreover, these increases were much larger than for the 22-country median, mainly because of divergent trends in

those older than 65 years. This extended period of atypically low mortality at older ages in England and Wales could have led to the survival of a subset of frail individuals whose death then occurred in the subsequent years, particularly with the notable increase in winter mortality linked to influenza in 2014–15.²⁸

The deficit of life expectancy at birth in England and Wales compared with the 22-country median was larger in 2016 than in 2001, 2006, or 2011 because in the period 2011–16, in every adult age group, mortality diverged between England and Wales and the 22-country median. However, starting in the mid-2000s, at ages 25–50 years in men and women, a new and pronounced excess mortality has emerged in England and Wales relative to the 22-country median. Mortality divergence at ages 15–49 years contributed 33% for males and 22% for females to the enlargements of the life expectancy gaps (in 2011–16) between England and Wales and the comparator median. Although these contributions are lower in absolute terms than those at ages 65 years and older, this finding is concerning. A similar finding among adults aged 15–40 years was previously observed in an analysis of Scottish mortality until 2010, relative to the rest of the UK and western Europe.²⁹

To understand this new phenomenon, an analysis by cause of death would be helpful. Unfortunately, for the period 2011–16, fully comparable and complete data on cause-specific observed mortality rates are not available for several of the 23 countries we have analysed. However, relative to the EU15 countries, in the most recent years the previous UK advantage in external cause mortality has been almost eliminated since 2010.

Analyses of age-specific and cause-specific trends in mortality in the UK throughout this period have been reported by others. A notable growth in regional disparities in England since the 1990s among people aged 25–44 years has been seen, attributable to sharp rises in deaths from cardiovascular causes, alcohol misuse, and drug misuse in the north compared with the south.³⁰ Other analyses have shown that from the late-2000s to 2016 mortality increased from all causes among people aged 30–34 and 40–49 years in England, with those aged 30–34 years showing the largest percentage increase (8%) of any age group.³¹ Mortality rates from external causes in adults aged 35–54 years in England, Wales, Scotland, and Northern Ireland have similarly increased over this period.⁷ However, without comparative data for the other 22 countries, we cannot know with certainty which causes have resulted in the increasing disparity with other countries in this age group.

How far the relative excess of mortality among working-age adults in England and Wales is transient is impossible to anticipate because the causes are unclear. One parallel is with what has happened in the USA. A 2013 study found that high US mortality among people younger than 50 years relative to people from a group of comparator countries accounted for two-thirds of the gap in male life

expectancy and two-fifths of the female gap.³² This mortality problem in this age group in the USA is at least partly driven by a combination of socioeconomic deprivation and a major problem of misuse of medicinal opioids.³³ However, although drug-related deaths in England and Wales have increased,³⁴ to date the increase has been on a smaller scale.³³ Further research to understand why adult mortality rates in England and Wales at working age and older ages are faltering relative to many other countries must be prioritised.

Much of the debate around the plateauing of life expectancy in the UK has focused upon the possible contribution of the UK Government's policy of austerity.^{35,36} Resources for the National Health Service and social care for older and susceptible people have been under increasing pressure in the past decade. However, the fact that there has been a slowdown in improvements in many countries suggests that at least part of the phenomenon is not the result of specific and unique UK Government policies and health and welfare spending. The health-care budgets of at least some of the comparator countries have also been constrained, which might partly explain the general tendency observed. We were unable to address this issue with the data we had available. Additionally, our results suggest that the adverse relative trends are driven equally by problems among people of working ages and not just among older people. Certainly, the emergence over the past 15–20 years of excess mortality in adults younger than 50 years in England and Wales relative to the 22-country median deserves further investigation.

UK Government policy has resulted in considerably increased hardship and poverty for many adults, children, and families,³⁷ which is additional to any effect of reduced government spending on the health sector per se.³⁶ Socioeconomic differences in mortality and life expectancy in the UK are widening.³⁸ A report showed that life expectancy in England and Wales in 2016–17 declined among women compared with in 2012–14 for the 30% of the population living in the most deprived areas, whereas life expectancy increased among those who were living in the least deprived areas.³⁹ For men, the most deprived areas did not show any improvement, whereas for those living in the least deprived areas, life expectancy continued to increase. This finding indicates that whatever the drivers are for the faltering in life expectancy in England and Wales, such causes are having an unequal effect on different sections of the population.

One factor that will influence the position of England and Wales compared with other high-income countries is the relative timing of the mortality effects of the smoking epidemic in other countries. For men and women in the UK the peak of the mortality effects of the epidemic has now passed, and thus will no longer have such a constraining effect on mortality improvements in England and Wales relative to other countries.

From a broader perspective, as populations age, progress in life expectancy becomes more difficult over

time because improvement depends increasingly on mortality reduction in old age. Nevertheless, exceptions exist. Life expectancy trends in 2011–16 have not slowed down in Italy, Japan, New Zealand, Norway, and Switzerland. These countries had higher life expectancies in 2011 than did England and Wales. Also, life expectancy continues to rise in highly educated groups, who have higher life expectancies than does any national population.⁴⁰ Thus, regardless of what the upper biological limit to longevity might be,⁴¹ these leading populations show that a substantial amount of lifetime is still to be gained for people in the UK and most other countries before they approach the limit.

Finally, this fairly optimistic outlook assumes that the configuration of economic and social forces that have operated since the middle of the 20th century, that have generally facilitated the advances in life expectancy, will not be undermined. Such stability is not a given, with the world facing major challenges, from climate change to the disruption of long-established aspects of international collaboration and cooperation, many of which have been important for progress in health.

Contributors

DAL and VMS conceived of the study. VMS, DAJ, and DAL contributed to the study design. VMS and DAJ acquired the data and undertook the statistical analyses. DAJ designed figure 2 and undertook the contour decomposition calculations. All authors contributed to the interpretation of results and drafting, revision, and approval of the manuscript.

Declaration of interests

We declare no competing interests.

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