

PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Recent adverse mortality trends in Scotland: comparison with other high-income countries.
AUTHORS	Fenton, Lynda; Minton, Jon; Ramsay, Julie; Kaye-Bardgett, Maria; Fischbacher, Colin; Wyper, Grant; McCartney, Gerry

VERSION 1 – REVIEW

REVIEWER	Domantas Jasilionis Max Planck Institute for Demographic Research
REVIEW RETURNED	24-Mar-2019

GENERAL COMMENTS	<p>The manuscript discusses long-term life expectancy trends in Scotland in international focus with a focus on recent slow-down in life expectancy improvement. This is an important piece of evidence complementing recent literature on stalling life expectancy improvements in some high income countries. The data and insights presented in the paper are likely to be very interesting for international readership. However, the current version of manuscript has several important limitations:</p> <ol style="list-style-type: none">1. The manuscript should be more focused in terms of temporal trends and international comparisons. Therefore, the core analyses should concern the period 1992 onwards with the main focus on the performance of Scotland if compared to the remaining UK and other high income countries. Inclusion of Central and Eastern European (CEE) countries is problematic. Faster recent improvements in life expectancy in these countries are to large extent attributable to recovery from a sudden mortality crisis in the mid-1990s and/or long-term stagnation dating back to the 1960s. In addition, one should take into account much lower initial levels of life expectancy and very specific context and determinants behind the life expectancy changes in this region.2. It is not entirely convincing how the authors deal with the sudden life expectancy decline observed in 2015. It has been shown by several studies that this is attributable to direct and indirect effects of sudden severe flu epidemics. It would be desirable to identify the importance of this year for the overall annual improvement rates in Scotland and elsewhere. This could be performed using sensitivity analyses excluding this particular year.3. The discussion should more highlight the historical origins and determinants behind the recent life expectancy disadvantage in Scotland (especially if compared to England & Wales). For example, it would be interesting to know which ages and causes of death explain the disadvantage in life expectancy. This would be
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	<p>an important information allowing to understand a potential of mortality reductions at various ages for further life expectancy improvement.</p> <p>4. The discussion should also provide a general context of life expectancy changes in high income countries. One of the explanations of the recent slow-down in life expectancy in high income countries concern entering a new stage of health transition. In the conditions of very low child and adult mortality, a new leap forward in longevity requires expansion of the progress in reducing mortality to increasingly advanced ages (beyond 80 and even 90). It seems that high income countries are now facing this challenge which leads to cross-country divergence. Although changes in life expectancy at birth are mainly driven by mortality at older ages, some countries (USA) show specific patterns such as additional burden of excess mortality at adult ages. Therefore, it would be important to understand the Scottish situation in this respect. Finally, it would be desirable to have at least few references to the most recent changes in socio-economic and policy context in Scotland. For example, it would be interesting to know about potential effects of recent anti-alcohol policies combatting alcohol-related mortality.</p> <p>Specific comments: Page 4, Background, lines 7-8. There have been previous exceptions to this general trend, including the countries of Eastern Europe during the 1990s. - life expectancy crisis (stagnation for women, deterioration for men) in the most of Eastern European countries started in the mid-1960s.</p> <p>Page 4, Background, lines 13-16 Contextualizing current mortality trends within those that have been observed previously and internationally can support a proportionate public health response, and identify comparator countries or periods to assist future investigation of causal hypotheses. - this sounds too complex and needs more elaboration. Public health response cannot be entirely based on past and international mortality data. Developing causal hypotheses would require more in-depth analyses, including contexts and determinants in the countries under comparison.</p> <p>Page 4, Background, lines 16-17 International comparison of changes in life expectancy across a single year (2014 to 2015) found that life expectancy declined in 8 out of 18 high-income countries, including the UK. - this should be carefully checked. My estimation is that life expectancy declined almost in all countries.</p> <p>Page 4, Background, lines 24-25 This however, does not allow identification of which period was exceptional: the previous gains or the current slow-down. - This is not so straightforward and one should look at long-term trends in life expectancy at birth across various countries. Some of them are showing continuing advances at the same pace, while some others are clearly suffer from slow-down (UK, Germany) or even reversal (USA).</p> <p>Pages 6, Results</p>
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	<p>The results section needs restructuring. I would recommend to start from providing a short general overview on historical trends in life expectancy at birth for Scotland, England & Wales, Northern Ireland, and other HMD countries. This would give an opportunity to highlight specifics of Scotland in international and UK context. Therefore, I would recommend to change Figure 1 (add life expectancy instead of changes in life expectancy) and/or move the figure on historical mean annual changes in life expectancy to the online annex. Since the article is focusing on recent slow-down in life expectancy, it would be more reasonable to show only the most recent (since 1992) changes in international context. Therefore, Figure 2 is sufficient.</p> <p>The main results should concern the period 1992-2016 as it is done in the lines 37-60. However, these paragraphs providing detailed numerical figures of life expectancy changes should be substantially shortened. Instead of providing data for every country, the results should be summarized by a) providing average, minimum, and maximum values and b) performing comparisons to the corresponding changes in Scotland. A short interpretation should be written about the relationship of these changes to the initial levels of life expectancy.</p>
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REVIEWER	Jessica Ho University of Southern California, United States
REVIEW RETURNED	01-Apr-2019

GENERAL COMMENTS	<p>This is an interesting paper that is in dialogue with several recently published papers on life expectancy trends in high-income countries.</p> <p>I find the overall justification for part of this study compelling – i.e., that it is helpful to examine life expectancy trends among several high-income countries over the longer-term in addition to the very recent trends highlighted by extant studies – but the authors could do more to justify the value of focusing on Scotland. What is it about Scotland’s experience that makes it particularly valuable as a focal country? What particular insights can we glean from Scotland, and to what extent is it more or less representative of the larger set of comparison countries? Part of this can be accomplished through providing more detail about the Scottish context for readers who may not be so familiar with its history and the major determinants of health and mortality in Scotland. For example, the authors should briefly summarize why Scotland has the lowest life expectancy levels among the UK countries.</p> <p>Page 4: “International comparison of changes in life expectancy across a single year (2014 to 2015) found that life expectancy declined in 8 out of 18 high-income countries, including the UK.4” This statement is incorrect – the referenced study found that life expectancy declined for 12 out of 18 countries for women and 11 out of 18 countries for men.</p> <p>For the age-standardized mortality rates, what was the open-ended age interval used? What is the particular justification used for differentiating between the two age groups, <75 and 75+?</p> <p>Figure 1: I’m surprised no life expectancy declines for Scotland were seen in the period that covers the 1918 influenza pandemic (1917-1921). In fact, the gains for 1917-1921 were quite large compared to those in the two surrounding periods (1912-1916 and 1922-1926). The 1918 influenza pandemic resulted in substantial life expectancy declines that were clearly observed in the HMD data for countries like Sweden and France, for example. Were the</p>
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life expectancy gains in Scotland in the years surrounding the 1918 large enough to compensate for influenza mortality? What is the justification for starting at 1990 for the segmented regression results rather than an earlier year? Based on Figure 1, the 2012-2016 gains for Scotland look somewhat similar in magnitude to what happened in 1957-1961 and 1972-1976. Is there any insight to be gained by looking at what happened during the earlier two periods of slow growth? If you were to run the segmented regression results over a longer period, would these two periods emerge as breakpoints, and would 1993 still emerge as a breakpoint?

Comparison countries: Compared to many prior studies in this area, this study includes a much more heterogeneous set of countries in the comparative analysis. This may be a potential strength of the study, but it also raises the question of how comparable the experiences of these countries are. It can also be difficult to make sense of these patterns. One suggestion is for the authors to group the countries by region (Western European, Eastern European, East Asian, etc.) or by the timing of their mortality transitions (early, late, intermediate). Also, it is not clear how the countries are being ordered in Figures 2 and 3. Please describe the logic for how the countries are arranged in the text or in notes accompanying the figures. It might be easiest to use the same country ordering for men and women.

Page 13, Discussion, paragraph 3: I recommend that the authors clarify that the segmented regression results are based only on Scotland, and not on data from all the other high-income countries. In general, I think the calls made by the authors for policy action (e.g., "In the meantime, governments at all levels should seek to provide public services according to need and sufficient social protection for all of their populations as key determinants of health. Providing effective vaccination programmes against influenza and sufficient health and social care capacity to deal with surges in demand is also required.") are rather strong considering that this particular article does not tie life expectancy trends to provision of public services, influenza, or health and social care capacity. Other studies have focused on specific ages and causes of death, such as influenza – if the authors are basing their policies on the results of these studies, it might be helpful to explicitly state that and reference those studies. Along related lines, I am somewhat confused by the section titled "Meaning – explanations and implications." The suggestion seems to be that austerity may play a role (albeit a complicated one) in recent slowdowns in life expectancy improvements. It would be helpful if the authors provided some information about the extent to which austerity policies were implemented in the 24 countries they consider so readers can see how well the patterns line up. To date, I have mainly come across austerity as a possible explanation in relation to the UK life expectancy trends, but not for other Western European countries, Eastern European countries, or Japan and Korea.

Appendix Figure 2 is quite interesting and, if space allows, could be moved to the main text. Readers may come in with the expectation that on average, countries with higher levels of life expectancy will experience smaller absolute gains because they are already at fairly high levels. Appendix figure 2 demonstrates fairly effectively that there is almost no relation between the level of life expectancy in 2011 and the mean annual gain in life expectancy 2012-2016 among women. It would be interesting to

	see the individual countries labeled or, if broad country groupings are used, to use those groupings in this figure. Page 6, paragraph 2: An error may have occurred in the upload/manuscript conversation process here: "(Error! Reference source not found.)"
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REVIEWER	Arun Hendi Princeton University, USA
REVIEW RETURNED	02-Apr-2019

GENERAL COMMENTS	<p>This study examines recent trends in mortality in Scotland and 23 other developed countries. Using data from the Human Mortality Database and the National Records of Scotland, the authors describe changes in mortality between the early 1990s (and earlier still for Scotland) and 2016, showing that most countries in their study experienced stagnating mortality in the 2012-2016 period. Relative to prior five-year periods, most countries experienced slower gains or no gains at all. They identify the year leading up to Q4 of 2012 and Q2 of 2014 as the inflection points for mortality stagnation in Scotland for men and women, respectively. This adds to the existing literature by using different time periods to examine recent mortality trends in context, and by identifying the precise timing of the mortality stagnation in Scotland. The data used is appropriate and the methods are standard and well-applied. I have only a few minor suggestions, detailed below.</p> <p>Minor Suggestions:</p> <p>(1) On page 4, the manuscript states that Ho and Hendi (2018) found that life expectancy declined in 8 out of 18 countries. Actually, Ho and Hendi 2018 found declines in male life expectancy for 11 countries and in female life expectancy for 12 countries.</p> <p>(2) Is it strictly necessary to have the pre-1950 mortality data for Scotland? It's unclear to me how it contributes to the study. Perhaps it's simply there to provide context?</p> <p>(3) On p. 6, lines 59-60: it appears that the Czech Republic and Austria also had larger gains in 2012-2016 than in 2007-2011 for men.</p> <p>(4) Is there something particular about the period leading up to 1993 Q4 for the first break to occur there?</p> <p>(5) On page 14, lines 4-5, the authors state that: "By extending life expectancy gain comparisons back over a longer time period we have sought to address concerns that the stalling of life expectancy in the most recent period may be over-emphasised due to notably large gains in the immediately preceding period." I think you need not be so equivocal here. It might be useful to explicitly point out that your results show that such concerns are unfounded--stalled gains in life expectancy are not the result of focusing on narrow time windows.</p>
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VERSION 1 – AUTHOR RESPONSE

R1C01	<p>1. The manuscript should be more focused in terms of temporal trends and international comparisons. Therefore, the core analyses should concern the period 1992 onwards with the main focus on the performance of Scotland if compared to the remaining UK and other high income countries. Inclusion of Central and Eastern European (CEE) countries is problematic. Faster recent improvements in life expectancy in these countries are to large extent attributable to recovery from a sudden mortality crisis in the mid-1990s and/or long-term stagnation dating back to the 1960s. In addition, one should take into account much lower initial levels of life expectancy and very specific context and determinants behind the life expectancy changes in this region.</p>	<p>We agree with the reviewer that the focus of the paper should be on the temporal trends and international comparisons. We have attempted to make this clearer throughout the paper.</p> <p>We disagree with the reviewer about the inclusion of the Central and Eastern European (CEE) countries. Our inclusion criterion for countries was that they be high-income and included data for 2016 at the point of data extraction. We did this to avoid any suggestion of picking countries to suit a particular hypothesis and to maximise comparability to Scotland. Although it is true that the life expectancy trends in CEE countries have been worse than in most other high income countries, the trends in Scotland have been somewhere between those in Western and Eastern Europe for some 30 years.</p> <p>Action: We have added references to this in both the introduction and discussion as follows to make this rationale clearer:</p> <p>“Since 1950, life expectancy trends in Scotland have followed a trajectory between slower improvements in Eastern Europe and faster improvements in Western Europe.^{1”}</p> <p>“We adopted the broad inclusion criteria of data availability and income level, in order to avoid any selection bias, and did not group or ascribe mortality characteristics to countries in advance of analysis. Thus several countries of Eastern Europe were included, which experienced a well-described decline and then recovery in life expectancy from the early 1990s.ⁱ It is possible that some of the recent faster improvements in Eastern Europe may be due to ‘catch-up’ following the ending of a negative exposure, however it is also instructive to find that these countries seem to be less affected by the recent stalling.”</p>
R1C02	<p>It is not entirely convincing how the authors deal with the sudden life expectancy decline observed in 2015. It has been shown by several studies that</p>	<p>We agree with the reviewer that the mortality rate change between 2014 and 2015 was particularly striking across many countries. Clearly many authors have suggested a role</p>

	<p>this is attributable to direct and indirect effects of sudden severe flu epidemics. It would be desirable to identify the importance of this year for the overall annual improvement rates in Scotland and elsewhere. This could be performed using sensitivity analyses excluding this particular year.</p>	<p>for influenza, but this does not preclude other factors being necessary or acting as effect modifiers (e.g. cuts to social care services), even if influenza is important and causal. Whilst the mortality that occurred in 2015 was particularly concerning, it is not clear from existing evidence that the causal factors driving mortality patterns that year operated independently of those which have contributed to wider recent mortality patterns. We are aware of a number of studies that are currently being undertaken to clarify the contribution of influenza, winter mortality, and the occurrence of deaths in 2015 to the overall recent trends.</p> <p>Action: We have undertaken a sensitivity analysis excluding 2015 data, as requested (figures 3 and 4, supplemental). This does alter the scale of change for some countries although the effects are very mixed. We have referred to this now in the text as follows:</p> <p>“When 2015 is excluded from the latest time period the stalling effect is less marked, although the scale of impact of this year varies, and for some countries, notably the USA this exclusion had little effect (figures 3 and 4, supplemental files 2 and 3).</p>
R1C03	<p>The discussion should more highlight the historical origins and determinants behind the recent life expectancy disadvantage in Scotland (especially if compared to England & Wales). For example, it would be interesting to know which ages and causes of death explain the disadvantage in life expectancy. This would be an important information allowing to understand a potential of mortality reductions at various ages for further life expectancy improvement.</p>	<p>We thank the reviewer for this suggestion and have added a new paragraph in the discussion in response to it:</p> <p>“The recent slowdown in improving life expectancies in Scotland follows from decades of relative health disadvantage in Scotland compared with other affluent countries. A comparison of age-specific mortality rates over time in Scotland compared with England & Wales found a growing disadvantage in mortality in younger working age since the 1980s, disproportionately affecting males, as well as persistent disadvantages at older ages, disproportionately affecting females.ⁱⁱ Increased rates and inequalities in suicide and drug-related deaths have been observed in young adults, and patterns of cause-specific death by age and year indicative of a cohort effect, with elevated hazards for</p>

		<p>cohorts who entered the labour market after the 'neoliberal' labour market reforms of the 1980s than for earlier cohorts, suggesting political economy as an underlying explanatory factor.ⁱⁱⁱ High rates of alcohol-related deaths, and steep socioeconomic gradients, also emerged over the 1990s and 2000s, affecting slightly older working ages. Scotland also has relatively high rates of deaths from circulatory disease in older ages, though trends in ischaemic heart disease have been improving since the early 1990s.^{iv}</p>
R1C04	<p>4. The discussion should also provide a general context of life expectancy changes in high income countries. One of the explanations of the recent slow-down in life expectancy in high income countries concern entering a new stage of health transition. In the conditions of very low child and adult mortality, a new leap forward in longevity requires expansion of the progress in reducing mortality to increasingly advanced ages (beyond 80 and even 90). It seems that high income countries are now facing this challenge which leads to cross-country divergence. Although changes in life expectancy at birth are mainly driven by mortality at older ages, some countries (USA) show specific patterns such as additional burden of excess mortality at adult ages. Therefore, it would be important to understand the Scottish situation in this respect. Finally, it would be desirable to have at least few references to the most recent changes in socio-economic and policy context in Scotland. For example, it would be interesting to know about potential effects of recent anti-alcohol policies combatting alcohol-related mortality.</p>	<p>The causes of the changing life expectancy trends across many high income countries is clearly a very important topic. There are many hypotheses for these trends, some with more or less evidence. This includes austerity, pressures on health and social care services, influenza, the role of drug-related deaths and cardiovascular disease improvement slowdowns, etc.</p> <p>Unfortunately, with this descriptive paper, it is not possible to shed light on this and other future papers will have to address the causes of this in more detail. We are somewhat reluctant to add to the speculation about the causes here, but we have added clarity on some points:</p> <p>First, it is not clear that this trend can be explained by a new stage of health transition since there is continued improvement in some of the countries with the highest life expectancy (e.g. Japan) and with continued increases in life expectancy amongst those within countries who already live the longest:</p> <p>“It seems less plausible that the trends can be explained as a natural limit to life expectancy or by a new stage of health transition since there is continued improvement in some of the countries with the highest life expectancy (e.g. Japan) and amongst those within countries who already have the longest life expectancy.”</p> <p>The causes of the decline in Scotland's alcohol-related mortality rates from 2003 are somewhat complex, but likely due to increased alcohol price and reduced</p>

		availability, with possible contributions from increased funding for alcohol treatment services (see http://dx.doi.org/10.1016/j.puhe.2015.12.013). We feel this is too specific in the context of this paper to go into in detail, but the contributions of specific causes of death in Scotland is the subject of another paper currently under review.
R1C05	Page 4, Background, lines 7-8. There have been previous exceptions to this general trend, including the countries of Eastern Europe during the 1990s. - life expectancy crisis (stagnation for women, deterioration for men) in the most of Eastern European countries started in the mid-1960s.	We have edited this sentence to read: “There have been exceptions to this general trend, including in countries of Eastern Europe where there were slower improvements from the 1960s and dramatic declines in the 1990s.”
R1C06	Page 4, Background, lines 13-16 Contextualizing current mortality trends within those that have been observed previously and internationally can support a proportionate public health response, and identify comparator countries or periods to assist future investigation of causal hypotheses. - this sounds too complex and needs more elaboration. Public health response cannot be entirely based on past and international mortality data. Developing causal hypotheses would require more in-depth analyses, including contexts and determinants in the countries under comparison.	Thank you for this comment. We have redrafted this section to simplify: “Describing the patterning of recent mortality trends can help understanding of the scale of the problem and identify comparator countries or periods to assist future investigation of causal hypotheses.”
R1C07	Page 4, Background, lines 16-17 International comparison of changes in life expectancy across a single year (2014 to 2015) found that life expectancy declined in 8 out of 18 high-income countries, including the UK. - this should be carefully checked. My estimation is that life expectancy declined almost in all countries.	Thank you for noting this error. We have corrected as follows: “International comparison of changes in life expectancy across a single year (2014 to 2015) found that life expectancy declined in 11 and 12 out of 18 high income countries, for men and women respectively...”.
R1C08	Page 4, Background, lines 24-25 This however, does not allow identification of which period was	There are clearly different approaches to examining the recent mortality trends, not least the time period for which to make comparisons to. We made the decision here

	<p>exceptional: the previous gains or the current slow-down.</p> <p>- This is not so straightforward and one should look at long-term trends in life expectancy at birth across various countries. Some of them are showing continuing advances at the same pace, while some others are clearly suffer from slow-down (UK, Germany) or even reversal (USA).</p>	<p>to examine periods between 1990 and 2016. Other work is planned to look at how likely changes of the scale identified here could be due to chance based on longer time series. It is, however, outside the scope of this paper.</p>
R1C09	<p>Pages 6, Results</p> <p>The results section needs restructuring. I would recommend to start from providing a short general overview on historical trends in life expectancy at birth for Scotland, England & Wales, Northern Ireland, and other HMD countries. This would give an opportunity to highlight specifics of Scotland in international and UK context. Therefore, I would recommend to change Figure 1 (add life expectancy instead of changes in life expectancy) and/or move the figure on historical mean annual changes in life expectancy to the online annex. Since the article is focusing on recent slow-down in life expectancy, it would be more reasonable to show only the most recent (since 1992) changes in international context. Therefore, Figure 2 is sufficient.</p>	<p>We note the reviewer's view here, however, it is not a result of this study to look at long-run trends in mortality across all of the countries we have included, only for Scotland. Instead, we have put more context into the introduction and discussion sections to make it much clearer how these results fill in.</p> <p>We believe Figure 1 is important to allow the reader to understand how unusual the changes in Scotland are, in historical terms. We do agree that this can be moved to a web supplement and have done so.</p>
R1C10	<p>The main results should concern the period 1992-2016 as it is done in the lines 37-60. However, these paragraphs providing detailed numerical figures of life expectancy changes should be substantially shortened. Instead of providing data for every country, the results should be summarized by a) providing average, minimum, and maximum values and b) performing comparisons to the corresponding changes in Scotland. A short interpretation should be written about the relationship of these changes to the initial levels of life expectancy.</p>	<p>See also R2C10. We agree the previous formulation of these paragraphs was overly verbose and have amended accordingly. Action taken: We have replaced the two paragraphs in the results section with the following paragraph, with minimum, maximum, mean and inter-quartile range for both genders. The full data informing figures 1 and 2 are now included as a supplemental table.</p> <p>"For the period 2012-2016 the range of mean life expectancy changes was -1.3 weeks/year to +14.5 weeks/year for females (interquartile range [IQR]: 3.3 to 10.0 weeks/year), and -1.7 to 20.6 weeks/year (IQR 7.8 to 14.0 weeks/year) for males. Mean gains of less than five weeks/year were seen in 9 countries for females, and 4 countries for males. Gains</p>

		<p>of 10 weeks/year or more were seen in 4 countries for females, and 14 countries for males. For both sexes, the mean annual increases were smaller in 2012-2016 than over 2007-2011 for nearly all countries, with Japan a notable exception for both sexes”</p> <p>In regards to the final point, about the relationship of these changes to the initial levels of life expectancy, we have now moved a figure from the appendix to the main manuscript, in response to comment R2C10, which addresses this issue.</p>
R2C01	<p>I find the overall justification for part of this study compelling – i.e., that it is helpful to examine life expectancy trends among several high-income countries over the longer-term in addition to the very recent trends highlighted by extant studies – but the authors could do more to justify the value of focusing on Scotland. What is it about Scotland’s experience that makes it particularly valuable as a focal country? What particular insights can we glean from Scotland, and to what extent is it more or less representative of the larger set of comparison countries? Part of this can be accomplished through providing more detail about the Scottish context for readers who may not be so familiar with its history and the major determinants of health and mortality in Scotland. For example, the authors should briefly summarize why Scotland has the lowest life expectancy levels among the UK countries.</p>	<p>We have added additional information on Scottish mortality and justification for this focus:</p> <p>“Since 1950, life expectancy trends in Scotland have sat between slower improvements in Eastern Europe and faster improvements in Western Europe. Scotland also has relatively wide health inequalities and additional premature mortality beyond that expected for the level of deprivation.”</p> <p>“The causes of the higher mortality and wider health inequalities in Scotland have been summarised as historical vulnerability combined with the changed politics from the 1980s onwards.”</p>
R2C02	<p>Page 4: “International comparison of changes in life expectancy across a single year (2014 to 2015) found that life expectancy declined in 8 out of 18 high-income countries, including the UK.4” This statement is incorrect – the referenced study found that life expectancy declined for 12 out of 18 countries for women and 11 out of 18 countries for men.</p>	<p>Thank you for spotting this error. We have now corrected this.</p>

R2C03	<p>For the age-standardized mortality rates, what was the open-ended age interval used? What is the particular justification used for differentiating between the two age groups, <75 and 75+?</p>	<p>An open-ended 90+ year age group was used.</p> <p>The selection of <75 and 75+ age groups was based on the basis of under 75 year mortality constituting premature mortality in current UK routine statistics.</p> <p>Action: the following clarifications have been added to the methods section:</p> <p>“Directly age-standardised mortality rates per 100,000 population for rolling four-quarter periods for Scotland were calculated (using the 2013 European Standard Population; upper age group 90+ years)”</p> <p>“Analyses were undertaken separately for males and females and for under 75 year and 75+ year age groups for both sexes, in keeping with the use of the under 75 year age group to calculate premature mortality in the UK.”</p>
R2C04	<p>Figure 1: I’m surprised no life expectancy declines for Scotland were seen in the period that covers the 1918 influenza pandemic (1917-1921). In fact, the gains for 1917-1921 were quite large compared to those in the two surrounding periods (1912-1916 and 1922-1926). The 1918 influenza pandemic resulted in substantial life expectancy declines that were clearly observed in the HMD data for countries like Sweden and France, for example. Were the life expectancy gains in Scotland in the years surrounding the 1918 large enough to compensate for influenza mortality?</p>	<p>See also R3C02 and R3C10. Action: We have now moved this figure to the appendix in response to another reviewer’s comments.</p> <p>We concede in response to R3C02 that life expectancy trends prior to 1950 are less relevant to the recent slowdown than trends since, but we included the figure to provide a longer-term context.</p> <p>It should be noted that, unlike some other records submitted to the Human Mortality Database, which covered total populations, the records for Scotland relate to the civilian population only. (i.e. the mortality data for Scotland, GBR_SCO, are more comparable to GBRCENW rather than GBRTENW for England and Wales, and FRACNP rather than FRATNP for France.)</p> <p>This, along with our use of five year averages, may explain an apparently lesser effect of the influenza pandemic for Scottish than the other populations mentioned, due to lesser exposure to the pandemic. However, as our focus is on recent trends, and the records for civilian and total populations are near identical after World War 2, we do not feel investigating this further would add substantively to this paper.</p>

R2C05	<p>What is the justification for starting at 1990 for the segmented regression results rather than an earlier year? Based on Figure 1, the 2012-2016 gains for Scotland look somewhat similar in magnitude to what happened in 1957-1961 and 1972-1976. Is there any insight to be gained by looking at what happened during the earlier two periods of slow growth? If you were to run the segmented regression results over a longer period, would these two periods emerge as breakpoints, and would 1993 still emerge as a breakpoint?</p>	<p>See also R3C04.</p> <p>We used the European Standard Population 2013, which is only recommended for use from 1994. However, we included data back to 1990 because we wanted our analyses to be comparable to some undertaken by the ONS.</p> <p>As per our response to R3C04, we agree that further analyses of faster and slower periods of life expectancy improvement would be worthwhile. This will be the subject of a future paper.</p> <p>Action: the following clarification has been added to the methods:</p> <p>“The 1990 start date was adopted as an acceptable application of the ESP 2013, and to permit comparison with analyses from England.Error! Bookmark not defined.”</p>
R2C06	<p>Comparison countries: Compared to many prior studies in this area, this study includes a much more heterogeneous set of countries in the comparative analysis. This may be a potential strength of the study, but it also raises the question of how comparable the experiences of these countries are. It can also be difficult to make sense of these patterns. One suggestion is for the authors to group the countries by region (Western European, Eastern European, East Asian, etc.) or by the timing of their mortality transitions (early, late, intermediate). Also, it is not clear how the countries are being ordered in Figures 2 and 3. Please describe the logic for how the countries are arranged in the text or in notes accompanying the figures. It might be easiest to use the same country ordering for men and women.</p>	<p>See also response to R1C01</p> <p>We thank the reviewer for noting the potential strength in a heterogeneous selection of countries. The inclusion criteria were intentionally open, in order that a range of mortality trajectories might be identified.</p> <p>Action: see text added in response to R1C01 which emphasises the rationale for inclusion criteria.</p> <p>In figures 2 and 3 (now 1 and 2) the countries are ordered on the size of life expectancy gain in the most recent 5 year period, as this is the primary period of concern. We feel this then permits visualisation of the preceding mortality trajectory in countries with both small and large recent life expectancy gains.</p> <p>Action: A note explaining the ordering has been added to the caption of each figure.</p>
R2C07	<p>Page 13, Discussion, paragraph 3: I recommend that the authors clarify that the segmented regression results are based only on Scotland, and not on data from all the other high-income countries.</p>	<p>Thank you for this recommendation.</p> <p>Action: We have made this change to the discussion.</p>

R2C08	<p>In general, I think the calls made by the authors for policy action (e.g., “In the meantime, governments at all levels should seek to provide public services according to need and sufficient social protection for all of their populations as key determinants of health. Providing effective vaccination programmes against influenza and sufficient health and social care capacity to deal with surges in demand is also required.”) are rather strong considering that this particular article does not tie life expectancy trends to provision of public services, influenza, or health and social care capacity. Other studies have focused on specific ages and causes of death, such as influenza – if the authors are basing their policies on the results of these studies, it might be helpful to explicitly state that and reference those studies.</p>	<p>We have updated our references in this section to make clear the basis for the recommendations we make.</p>
R2C09	<p>Along related lines, I am somewhat confused by the section titled “Meaning – explanations and implications.” The suggestion seems to be that austerity may play a role (albeit a complicated one) in recent slowdowns in life expectancy improvements. It would be helpful if the authors provided some information about the extent to which austerity policies were implemented in the 24 countries they consider so readers can see how well the patterns line up. To date, I have mainly come across austerity as a possible explanation in relation to the UK life expectancy trends, but not for other Western European countries, Eastern European countries, or Japan and Korea.</p>	<p>Our evidence that austerity may be playing a role does not come from this paper, but instead from the existing literature.</p> <p>Action: We have made this clearer as follows:</p> <p>“There is good evidence now available that this impacted negatively on mortality rates and self-rated health.^{29, 30, 31}”</p> <p>The papers we cite provide good evidence across high-income nations.</p>
R2C10	<p>Appendix Figure 2 is quite interesting and, if space allows, could be moved to the main text. Readers may come in with the expectation that on average, countries with higher levels of life expectancy will experience smaller absolute gains because they are already at fairly high levels.</p> <p>Appendix figure 2 demonstrates fairly effectively that there is almost no relation between the level of life expectancy in</p>	<p>Action taken: This figure has now been redrawn to include individual country labelling, and moved to the main manuscript (as figure 7). We have also added the following paragraphs the results and discussion sections, respectively:</p> <p>“The relationship between starting life expectancy in 2011 and subsequent mean annual change in life expectancy (in weeks) from 2012-2016 is shown in figure 7, for males and females separately, and for each</p>

	<p>2011 and the mean annual gain in life expectancy 2012-2016 among women. It would be interesting to see the individual countries labeled or, if broad country groupings are used, to use those groupings in this figure.</p>	<p>of the countries considered. This indicates that subsequent life expectancy gains tended to be slightly smaller in countries that had higher life expectancies in 2011, but this relationship is very weak, especially for females, where the R-squared value is 0.05”</p> <p>“Scotland has had marked stalling in spite of a comparatively low life expectancy in 2011, and there is a generally weak relationship between life expectancy and mean life expectancy gains internationally. This suggests that recent adverse mortality trends are not due to any ‘natural’ long-term tendency for life expectancy gains to slow down in high-income countries. “</p>
R2C11	<p>Page 6, paragraph 2: An error may have occurred in the upload/manuscript conversation process here: “(Error! Reference source not found.)”</p>	<p>This error is not visible on our version.</p>
R3C01	<p>(1) On page 4, the manuscript states that Ho and Hendi (2018) found that life expectancy declined in 8 out of 18 countries. Actually, Ho and Hendi 2018 found declines in male life expectancy for 11 countries and in female life expectancy for 12 countries.</p>	<p>Thank you for alerting us to this.</p> <p>Action: We have made this correction.</p>
R3C02	<p>(2) Is it strictly necessary to have the pre-1950 mortality data for Scotland? It's unclear to me how it contributes to the study. Perhaps it's simply there to provide context?</p>	<p>We agree that post-war trends are of more relevance to recent trends, but pre-1950 data are available and, as you suggest, are helpful for providing broader context to these recent trends.</p> <p>Action: Figure 1 has now been moved to be a supplementary web figure.</p>
R3C03	<p>(3) On p. 6, lines 59-60: it appears that the Czech Republic and Austria also had larger gains in 2012-2016 than in 2007-2011 for men.</p>	<p>See also R1C10.</p> <p>Thank-you for this careful observation, both were <1.0 weeks per year greater. In order to address another reviewer’s suggestion, we have now included the full data for figures 1 and 2 as a supplemental table (table 1) to provide greater clarity. The relevant manuscript text has been amended and now reads:</p> <p>“For both sexes, the mean annual increases were smaller in 2012-2016 than over 2007-</p>

		2011 for nearly all countries, with Japan a notable exception for both sexes.”
R3C04	(4) Is there something particular about the period leading up to 1993 Q4 for the first break to occur there?	<p>This is an interesting question but we are unable to answer this question with the data available. A future paper will examine the extent to which the faster improvements after 1993 were unusual.</p> <p>Action: We have added a note to this effect in the discussion:</p> <p>“We also need to understand the degree to which the relatively rapid improvements across the UK during the late 1990s and 2000s were unusual.”</p>
R3C05	(5) On page 14, lines 4-5, the authors state that: "By extending life expectancy gain comparisons back over a longer time period we have sought to address concerns that the stalling of life expectancy in the most recent period may be over-emphasised due to notably large gains in the immediately preceding period." I think you need not be so equivocal here. It might be useful to explicitly point out that your results show that such concerns are unfounded--stalled gains in life expectancy are not the result of focusing on narrow time windows.	<p>Action: We have added an additional sentence after these lines to emphasise this useful point.</p> <p>“Our results using a longer time period show that such concerns are unfounded.”</p>

VERSION 2 – REVIEW

REVIEWER	Domantas Jasilionis Max Planck Institute for Demographic Research, Germany
REVIEW RETURNED	13-Aug-2019

GENERAL COMMENTS	<p>I have only few last comments:</p> <p>Page 4. lines 6-7: "There have been exceptions to this trend, including in countries of Eastern Europe where there were slower improvements from the 1960s and dramatic declines in the 1990s. - This is not precise. Male life expectancy in Russia, Estonia, Latvia, Lithuania, Belarus, and Ukraine was declining between the mid-1960s and mid-1980s.</p> <p>Page 12, lines 33-37. "It seems less plausible that the trends can be explained as a natural limit to life expectancy or by a new stage of health transition since there is continued improvement in some of the countries with the highest life expectancy (e.g. Japan) and amongst those within countries who already have the longest life expectancy.[35]".</p>
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	- The statement regarding the approaching new stage of health transition is disputable because the authors acknowledge the role of rising mortality due to dementias and Alzheimer's diseases. Both of them are attributable to ageing-related diseases which are thought to be the markers of the new emerging stage of health transition. Regarding the continuing improvements in the countries with the highest life expectancy, some original references should be used instead of referring to a report by Scottish government. For example: Lenart A, Vaupel JW. Questionable evidence for a limit to human lifespan. Nature. 2017 Jun 28;546(7660):E13-E14. doi: 10.1038/nature22790.
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REVIEWER	Jessica Y. Ho University of Southern California, United States
REVIEW RETURNED	06-Aug-2019

GENERAL COMMENTS	The authors have addressed my comments in their revision.
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REVIEWER	Arun Hendi Princeton University, USA
REVIEW RETURNED	30-Jul-2019

GENERAL COMMENTS	The authors have addressed most of my concerns. I disagree with the claim that, "...segmented regression of the full period of mortality rates available offers an objective method of identifying the timing of a change in trend" but I also recognize that any other method would be just as subjective. Also, it's unclear why the authors have dropped the reference to the HMD database, since that data is still used in this study.
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VERSION 2 – AUTHOR RESPONSE

Reviewer 3 Comment 1	The authors have addressed most of my concerns. I disagree with the claim that, "...segmented regression of the full period of mortality rates available offers an objective method of identifying the timing of a change in trend" but I also recognize that any other method would be just as subjective.	We accept that there will be subjectivity in any method selected, and have changed the summary statement to: "Segmented regression provides a means of identifying the timing of a change in trend."
Reviewer 3 Comment 2	Also, it's unclear why the authors have dropped the reference to the HMD database, since that data is still used in this study.	Thank-you for noticing this error. Whilst the HMD was still referenced (19), it was incorrectly cited due to updating the reference system. This has now been corrected and the citation provided as: "Human Mortality Database. University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). www.mortality.org (data downloaded on [09/01/2019])" and reference

		<p>to this made at all relevant points in the manuscript.</p> <p>All other references have also been re-checked in light of this.</p>
Reviewer 1 Comment 1	<p>Page 4. lines 6-7: "There have been exceptions to this trend, including in countries of Eastern Europe where there were slower improvements from the 1960s and dramatic declines in the 1990s.</p> <p>- This is not precise. Male life expectancy in Russia, Estonia, Latvia, Lithuania, Belarus, and Ukraine was declining between the mid-1960s and mid-1980s.</p>	<p>Thank-you for highlighting this imprecision. We have changed the text to: "There have been exceptions to this trend, for example in Russia and the Baltic states where life expectancy declined steadily from the 1960s, and then more dramatically in the 1990s."</p>
Reviewer 1 Comment 2	<p>Page 12, lines 33-37. "It seems less plausible that the trends can be explained as a natural limit to life expectancy or by a new stage of health transition since there is continued improvement in some of the countries with the highest life expectancy (e.g. Japan) and amongst those within countries who already have the longest life expectancy.[35]".</p> <p>- The statement regarding the approaching new stage of health transition is disputable because the authors acknowledge the role of rising mortality due to dementias and Alzheimer's diseases. Both of them are attributable to ageing-related diseases which are thought to be the markers of the new emerging stage of health transition.</p>	<p>We have restricted this discussion point to reflect the relationship between life expectancy and life expectancy improvement, as follows: "It seems less plausible that the trends can be explained as a natural limit to life expectancy, since there is continued improvement in some of the countries with the highest life expectancies, such as Japan."</p>
Reviewer 1 Comment 3	<p>Regarding the continuing improvements in the countries with the highest life expectancy, some original references should be used instead of referring to a report by Scottish government. For example: Lenart A, Vaupel JW. Questionable evidence for a limit to human lifespan. Nature. 2017 Jun 28;546(7660):E13-E14. doi: 10.1038/nature22790</p>	<p>Agreed. Thank-you for noting this and suggesting alternative.</p>

VERSION 3 – REVIEW

REVIEWER	Domantas Jasilionis Max Planck Institute for Demographic Research, Germany
REVIEW RETURNED	02-Sep-2019

GENERAL COMMENTS	I do not have any further comments.
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REVIEWER	Arun Hendi Assistant Professor of Sociology and Public Affairs, Princeton University, USA
REVIEW RETURNED	29-Aug-2019

GENERAL COMMENTS	The authors have addressed my concerns. I have no further comments.
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