**Response to reviewers**

**José Manuel Aburto, Maarten Wensink, Alyson van Raalte & Rune Lindahl-Jacobsen.**

Odense, June 6, 2018

We gratefully acknowledge that the comments of both reviewer were very constructive and have improved the paper. We essentially accommodate all of them; there were no points of disagreement. Below, we outline how we have adjusted to manuscript so as to take account of these comments. (In ***bold italic*** below comments). We thank the reviewers for these suggestions.

[José, comments to you between square brackets.]

Reviewer reports:

Henrik Bronnum-Hansen (Reviewer 1): This study gives more insight into the cause of the long lasting and disturbing mortality trends in Denmark. The authors simultaneously investigate trends in life expectancy, lifespan inequality and decomposition by cause of death.

The manuscript is well written and my comments, questions and suggestion are few:

1. Although life expectancy is well known, lifespan may be less. So as a service for readers not in well-informed circles I recommend to introduce the definition(s) or the overall concept(s) of (life expectancy and) lifespan in the introduction of the paper before describing the characteristics of the two health indicators.

***We have clarified the terms in the first two sentences of the introduction.***

2. The first sentence on page 3 should start "Life expectancy is one of the most commonly used measure…", because health expectancy and other summary measures of population health become increasingly more widespread.

***We have adjusted the first sentence on page 3 accordingly.***

3. I suggest that you add a little more explanation to the sentence (page5-6): "We also checked for discontinuities in death counts…"? In Figure 2-4 "ICD7" is missing in the description of categories. I am not sure that I understand how to interpret the graphs.

***Two lines giving further explanation have been added in the main text. A detailed caption has been added to Supplementary Figures 2-4.***

***[J, do we want to label these figures separately, even though it is clear which one is which? Also, the colors of the vertical lines are not consistent between countries.]***

4. Please, add extra information in the title of Figure 2 (similar to that of Supplementary Figure 1).

**[José, this one is for you. You may point out that Figure 2 has arrows instead, but perhaps this should be consistent?]**

5. In the Supplemental material "2) Brief description of the indicator" this is named CV. Change that to CoV as this is used in the text. Also chance "e0" to "ea" in the explanatory text to the formula (1).

***We have made the suggested changes.***

***[J, the probable source of this confusion is that the equation works for all starting ages, and you can play around with this in the app, but in the paper we work from age 0.]***

Sasson Isaac (Reviewer 2): This is an interesting descriptive paper looking at changes in life expectancy and lifespan inequality in Denmark from 1960 to 2014. The authors hypothesize that (1) Denmark will exhibit greater lifespan inequality relative to its neighboring countries; and (2) Life expectancy and lifespan inequality (variability) will stagnate between 1975 and 1995, primarily among women, due to higher smoking prevalence in the 1919-1939 birth cohorts.

Using HMD mortality data and WHO cause-of-death data, the authors find support for both hypotheses and point to possible health interventions with respect to infant mortality and cancers, which were responsible for the bulk of those patterns/trends (i.e., life expectancy and lifespan inequality improvements over time and relative to similar countries).

Overall, the paper is well written and the methods are appropriate. To their credit, the authors were mindful of possible limitations (e.g., ICD classification discontinuities, reliability of cause-of-death classification in old age) and addressed them in a satisfactory manner, either in the main analyses or in supplementary sensitivity analyses.

A few remaining suggestions:

1. The comparison with Sweden received substantial exposition (p. 3 second paragraph), as well as subsequent analyses (cause-of-death decomposition in Fig. 3), but not Norway. For example, Fig. 2 shows that Norway experienced similar stagnation in life expectancy and (more so) in lifespan variation from 1975-1995. In other words, Norway was closer to Sweden in levels but more similar to Denmark in trends. However, this similarity is not explored or explained, so I recommend that the authors either bolster the Denmark-Norway comparison or drop this third country altogether.

***[J, you have some ideas about this? I would add a few lines rather than dropping Norway. To me, only the Norwegian stagnation in CoV stands out; not in life expectancy. This is a point where Rune may add.]***

2. The findings suggest that smoking-related cancers and non-infectious respiratory diseases had largely driven the stagnation in life expectancy from 1975-1995. Those same causes were responsible for positive contributions to lifespan inequality below age 70 (among women) and negative contributions in older ages—both of which attributed to rising smoking-related mortality across the board. In other words, the negative contributions from smoking were also undesirable, because they resulted from increasing mortality above the young-old threshold age, which the authors acknowledge in the discussion section (p. 11). I suggest introducing this concept earlier in the paper and plotting the threshold age in Fig 2, Panel B to make this point clearer.

***An explanation to this effect has been added in the Introduction. The threshold age has been included in Figure 2.***

3. The authors relied on CoV to measure lifespan inequality. However, because this measure is directly dependent on life expectancy, the interpretation of the findings (particularly comparison with other countries) is not always straightforward. For example, the CoV diverged between Denmark and Sweden in the 1980s, but we cannot tell whether the Swedish CoV declined because of absolute reductions in SD (numerator) or simply increases in life expectancy (denominator). Both effects would reduce the CoV, but each corresponds to a different mortality scenario (compression vs. translation). Therefore, I suggest applying alternative measures of lifespan inequality either in the main analyses or to be included in supporting materials.

***[J, we talked about this.]***

4. It appears that non-smoking cancers also contributed to reductions in life expectancy and increases in lifespan inequality during the 1975-1995 period. Can the authors explore this further? Is this because their definition of smoking-related cancers was conservative, as explained in the Supplementary Materials, so some of the effect of smoking is captured in the remaining cancers? Or was there an overall cancer crisis (e.g., diagnosis, treatment) going on in Denmark? This is relevant to the interventions discussed at the end of the paper.

***This is an interesting question. The conservative definition of smoking-related cancers will certainly be part of the explanation (the extent of which cannot be reconstructed with these data). It is also well-known that women of the interwar generation engaged in more risky behavior than just smoking (drinking is another one), consistent with higher external mortality reducing life expectancy and increasing lifespan inequality in Figure 2 through mortality in the ages 44-55 in the period 1960-1975. Other risk-taking behavior may well have led to increased cancer rates through mechanisms other than smoking. Finally, it is well-known (in Denmark) that Denmark was a laggard in terms of cancer mortality, leading to various cancer plans from 1990 onwards, making progressive improvement (a lot has been done already).***

***[J, we should decide on how much we want to discuss this in the paper. I think this is also a point to bring to Alyson’s attention, see if she agrees.]***

5. Phrasing: p. 11, first paragraph: "Therefore, the causes that extend lifespan and the causes that reduce inequality are not necessarily the same." I recommend changing "lifespan" to "average lifespan" or "life expectancy" so there is no confusion with "maximal lifespan."

***We have adjusted the manuscript accordingly.***