Reply to reviewers
We appreciate the reviewers' comments; their detailed reading of the manuscript and many suggestions that have greatly improved the article. Our responses to the reviewers' comments are outlined below in regular font with reviewer's comments in bold font.

Reviewer 1

We thank the reviewer for her/his suggestions. The paper has been revised and re-organized accordingly. Below are the changes/responses to her/his comments.

The submitted article represents a solid research finding in the field of lifespan inequalities, focused on the region of Central and Eastern Europe. The studied file of countries represents a known exception from the epidemiologic transition theory and the extension to the study of lifespan disparities seems needed and novel. The authors use advanced methods of lifespan dispersion decomposition and its suitable graphical representation.

The text is well structured, however we surprisingly find the main findings already at the end of the introduction. The first section of Results should be called „Age specific rates of mortality improvement". Different analyses use different distinction of periods, ranging from 3 to 5. Authors explain that period were defined statistically but the final selection doesn't correspond to what is described in footnote No.4.

We thank the reviewer for her/his observations. The text containing the main findings at the end of the introduction was deleted from this section and merged with the first paragraph of the discussion to highlight the main contribution of the study. It now reads:

"*… Over the study period, the acute mortality crises of the 1990s caused greater year-to-year fluctuation in lifespan variation than in life expectancy. Life expectancy and life disparity moved independently from one another, particularly during periods of life expectancy stagnation caused by uneven age-specific mortality change. Fluctuations in life disparity were, to a large extent, caused by fluctuation in mid-life mortality that was directly or partially attributable to mortality amenable to alcohol consumption, with different net effects depending on the country and time period.*"

The first section of Results is now called "*Age specific rates of mortality improvement*", as suggested.

It is true that the analyses differed in terms of the distinction of the periods. To make the analysis consistent, Figure 2 now includes the two additional periods that are shown in the subsequent figures and it has been described accordingly. Now it looks like:

The statistical break points in slope changes in the coefficient of variation for male life expectancy between countries were 1960, 1976, 1986, 1993 and 2001. We instead used complete decades or historical events which made the interpretation of the results easier than having used these exact break points, which were all within 3 years of the cut points. For example, the period 1960-1979 (complete years) included the two decades with no substantial changes in the coefficient of variation between life expectancies. The next break point (1986) was extended to 1988 to include completely Gorbachev's anti-alcohol campaign, which was implemented in the period 1985-1988. This campaign was an unprecedented effort- in both scale and scope- to control supply and demand of alcohol and, simultaneously raising the effective price of drinking and subsidizing substitutes for alcohol consumption (Bhattacharya et al 2013). Additionally, this campaign was partly the reason of the rise in life expectancy in those years (Leon et al 1997, Bobadilla et al 1997, Cockerman 1999). The following break point was used exactly since it allows the period 1988-1993 to include the dissolution of the Soviet Union in late 1991 and the largest drops in life expectancy in Russia, Latvia, Estonia, Lithuania, and less marked in Ukraine, Belarus, and Bulgaria in 1992-1993 (see Figure 2 in the manuscript and HMD 2018). Finally, the year 2001 was changed to 2000 to start with the 21st century.

We understand the concern about why we did not instead use the (potentially more objective) statistical breaks. To demonstrate that this had little impact on our results, we have recreated the association figure with the statistically determined cut-off periods (see below). Our selection does not change the main results compared with the statistically found ones. In fact, the statistically determined breaks actually result in a marginally higher number of positively correlated changes in life expectancy and lifespan disparity for every period (see table below). In addition, we have created an interactive app (https://demographs.shinyapps.io/CEE_App/). In this app, the reviewers (and later the readers) can select the years (Association results by period and Decomposition results by period panels) selected statistically (or any combination) and see how sensitive the results are to the selection of the periods. We hope this will alleviate any potential reader concerns that we might have cherry picked dates to strengthen our arguments.

Results with statistical break points:

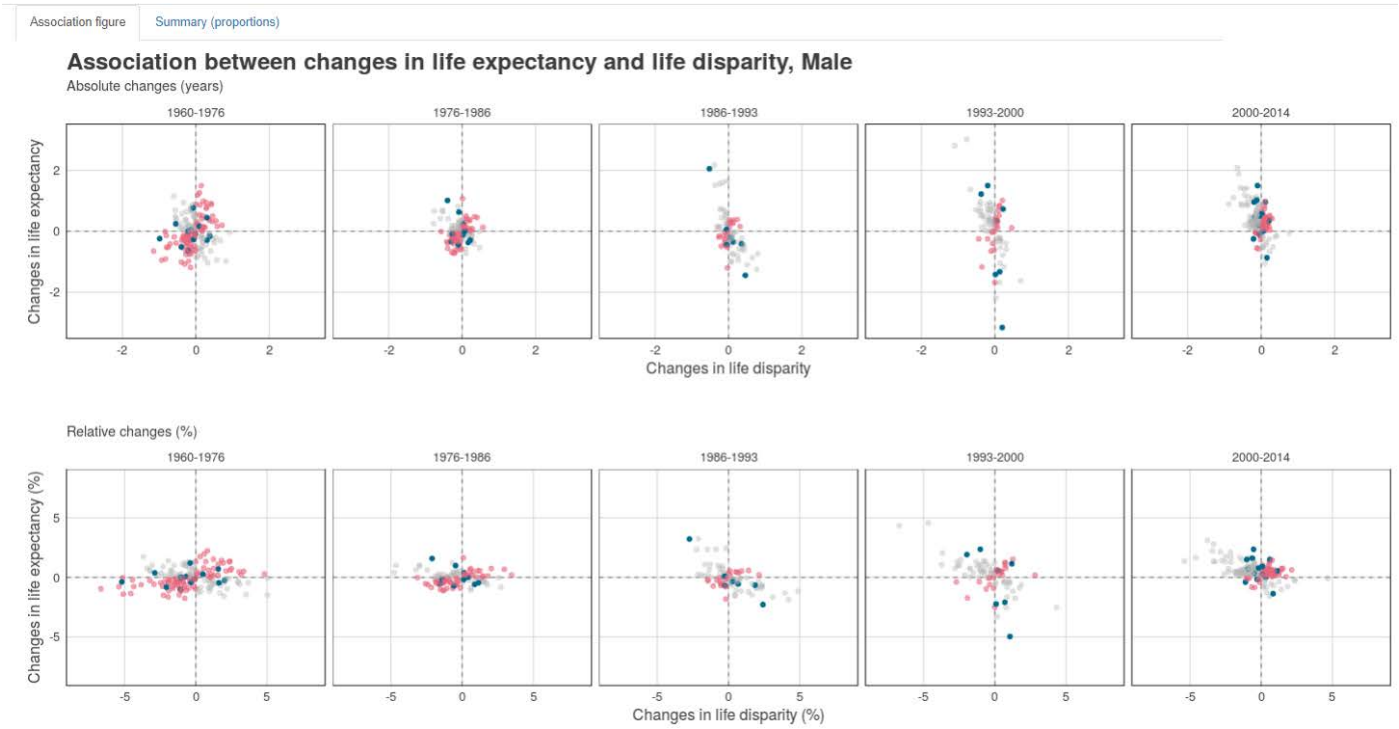


Table. Proportions of changes in life expectancy and lifespan variation in the same and opposite direction, using statistically determined break points versus historically determined break points. “Expected direction” refer to mortality change that caused either a simultaneous increase in life expectancy and decrease in life disparity or vice versa. Changes in an ‘unexpected direction’ were when both indices either increased or decreased together (aka weakening the commonly observed negative correlation).

Period	Years		Unexpected direction		Expected direction	
	Statistical	Historical	Statistical	Historical	Statistical	Historical
Stagnation	1960-1976	1960-1980	58.6	55.5	41.4	44.5
Improvements	1976-1986	1980-1988	54.8	47.3	45.2	52.7
Deterioration	1986-1993	1988-1994	25.0	22.2	75.0	77.8
Divergence	1993-2001	1994-2000	31.7	31.7	68.3	68.3
Convergence	2001-2014	2000-2014	37.2	34.9	62.8	65.1

In addition, we described clearly how the periods were determined in the methods sections. We added the next paragraph:

“We focused on five periods determined by trends in the coefficient of variation of male life expectancy. The periods were labeled ``Stagnation' from 1960 to 1980, ``Improvements'' from 1980 to 1988, ``Deterioration'' from 1988-1994, ``Divergence between 1994 and 2000, and ``Convergence'' thereafter. Periods were initially determined using a divisive hierarchical estimation algorithm for multiple change points analysis. The statistical break points were 1960, 1976, 1986, 1993 and 2001. We instead used complete decades or historical events which made the interpretation of the results easier, which were all within 3 years of the cut points. For example, the period 1960-1979 (complete years) included the two decades with no substantial changes in the coefficient of variation between life expectancies. The next break point (1986) was extended to 1988 to include completely Gorbachev’s anti-alcohol campaign, which was implemented in the period 1985-1988. The following break point was used exactly since it allows the period 1988-1993 to include the dissolution of the Soviet Union in late 1991 and the largest drops in life expectancy in Russia, Latvia, Estonia, Lithuania, and less marked in Ukraine, Belarus, and Bulgaria in 1992-1993. Finally, the year 2001 was changed to 2000 to start with the 21st century.”

References:

Bobadilla, J. L., Costello, C. A., Mitchell, F., & National Research Council (US) Committee on Population. (1997). The Anti-Alcohol Campaign and Variations in Russian Mortality.

Bhattacharya, J., Gathmann, C., & Miller, G. (2013). The Gorbachev anti-alcohol campaign and Russia's mortality crisis. American Economic Journal: Applied Economics, 5(2), 232-260.

Cockerham, W. C. (1999). Health and social change in Russia and Eastern Europe. Psychology Press.

Leon, D. A., Chenet, L., Shkolnikov, V. M., Zakharov, S., Shapiro, J., Rakhmanova, G., ... & McKee, M. (1997). Huge variation in Russian mortality rates 1984–94: artefact, alcohol, or what?. The lancet, 350(9075), 383-388.

Wilmoth, J. R., & Shkolnikov, V. (2008). Human mortality database. University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany).

The decomposition method should be better explained. It is rather unclear what is the threshold age (mentioned later in results section) which differentiates ages which compress / expand the mortality and how is it computed.

We added a paragraph explaining with more detail the decomposition method and how the age-cause specific effects between two time points are derived following the line integral model (Horiuchi et al 2008):

"*The decomposition method used in this paper is based on the line integral model (Horiuchi et al 2008). Suppose f (e.g. $e^\dagger$ or life expectancy) is a differentiable function of n covariates (e.g. each age-cause specific mortality rate) denoted by the vector $\boldsymbol{A} = [x_1, x_2, \dots, x_n]^T$. Assume that f and $\boldsymbol{A}$ depend on the underlying dimension t, which is time in this case, and that we have observations available in two time points t_1 and t_2. Assuming that $\boldsymbol{A}$ is a differentiable function of t between t_1 and t_2, the difference in f between t_1 and $t_2$can be expressed as follows:*

$$f_2 - f_1 = \sum_{i=1}^{n} \int_{x_i(t_1)}^{x_i(t_2)} \frac{\partial f}{\partial x_i} dx_i = \sum_{i=1}^{n} c_i, \qquad (2)$$

where c_i is the total change in f (e.g. $e^\dagger$ or life expectancy) produced by changes in the i-th covariate, x_i. The c_i's in equation (2) were computed with numerical integration following the algorithm suggested by Horiuchi et al (2008). This method has the advantage of assuming that covariates change gradually along the time dimension.

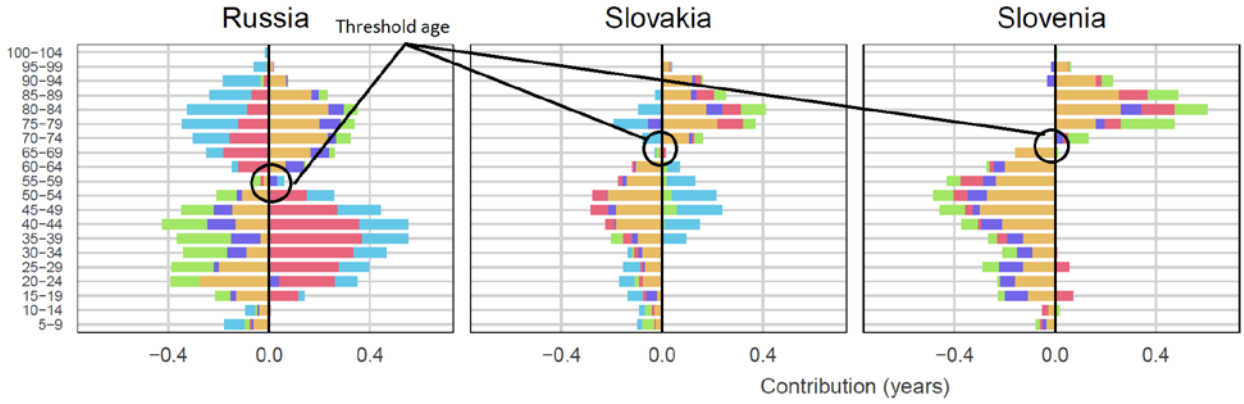
We perform such decomposition by single age, period and cause of death.."

The threshold age is the age at which mortality improvement has no effect on changing life disparity ($e^\dagger$), and has been taken as the indicator that separates premature and late deaths (Zhang & Vaupel 2009, Vaupel et al 2011). Improvements below this age decrease disparity and improvements above increase life disparity. It exists for several lifespan variation indicators and varies across them (Van Raalte & Caswell 2013). However, it is not fixed and it is different for each country in each time depending on the mortality profile. While presenting results on the threshold age would add unnecessary complexity to an already dense paper, you are right in highlighting that it is necessary to be aware of its existence for interpretation of the age-specific analysis. In figures 4-6, there is a clear break in age-specific patterns (e.g. Russia ages 55-59, Slovakia 65-69, Slovenia 70-74, etc. [see Fig below]), which indicates that around those ages is the so-called threshold age. Its importance relies in the fact that, for example, even though life disparity did not change significantly in the period 1960-1980, when looking at age-specific effects it becomes clear that it was a result of offsetting effects of early and midlife mortality patterns with changes in old age mortality. To clarify what the threshold age is, we have included an explanation in the methods section as a property of $e^\dagger$:

"*… An important attribute of $e^{\dagger}$ is the so-called threshold age at which mortality improvements have zero effect on lifespan variation (Zhang & Vaupel 2009). Progress in saving lives below this age reduces variation (also called premature deaths), whereas progress above this age increases variation in lifespans (Vaupel et al 2011).*"

We also explain in the Results section that by visual inspection the threshold age occurs around the age-groups where changes in lifespan variation are usually the lowest in Figures 4-6:

"*…The threshold age occurs around the age-groups where changes in lifespan variation are usually the lowest by period (e.g. Russia ages 55-59, Slovakia 65-69, Slovenia 70-74). Bars on the left (decreases in variation) come about from mortality decrease at young ages or increase at old ages, separated by the threshold age. Conversely, bars on the right (increase in variation) are produced by mortality increase at young ages or mortality decrease at old ages…*"



References:

Horiuchi, S., Wilmoth, J. R., & Pletcher, S. D. (2008). A decomposition method based on a model of continuous change. Demography, 45(4), 785-801.

Van Raalte, A. A., & Caswell, H. (2013). Perturbation analysis of indices of lifespan variability. Demography, 50(5), 1615-1640.

Vaupel, J. W., Zhang, Z., & van Raalte, A. A. (2011). Life expectancy and disparity: an international comparison of life table data. BMJ open, 1(1), e000128.

Zhang, Z., & Vaupel, J. W. (2009). The age separating early deaths from late deaths. Demographic Research, 20, 721-730.

I have a concern regarding the inclusion of infant mortality in the analysis. According to the authors, including infant mortality is important because of its overall impact and because excluding it would require arbitrary censoring of the age scale. Infant mortality in the Eastern countries has however undergone huge artificial changes due to updates of diverse non-standard definitions of live births (which are not corrected in the HMD data). These changes may impact life expectancy and lifespan dispersion differently. Including infant mortality is also in conflict with the aim of the paper, which focuses at adult/elderly mortality and particularly at the effects of alcohol.

We thank the reviewer for these observations and comments. Eastern European mortality patterns raise questions about quality and completeness of the data. Considering that infant mortality was underestimated before switching from the Soviet to WHO definition of live birth (Aleshina and Redmond 2005, Anderson and Silver 1986, UNICEF 2003), it would bias our results to the extent that lifespan variation would have been (artificially) larger under the Soviet definition, and declines in lifespan variation would have been more dramatic than observed during the transition. More subtly, while the levels would have differed, the trends pre-1990 would have been the same, assuming that the Soviet definition was used consistently over the period. Post-1990 there were differences in the speed of adoption of the WHO rules which could also have led to some biases.

However, we believe that including infant mortality is not in conflict with the aim of the paper. It is true that life expectancy and especially lifespan variation are highly sensitive to changes in early ages in some periods (van Raalte and Caswell 2013). By using appropriate decomposition techniques, we could disentangle its effect and analyze age-specific effects above infant mortality. In general, all lifespan variation measures depend on which age is taken as the starting point (Engelman et al. 2010), and we believe that major improvements in very early ages, infant mortality and under five particularly, are undeniable from 1960 in the region even controlling for the change in definition (Kingkade and Sawyer 2001). Therefore, they should not be overlooked.

To show how sensitive our results are with respect to the starting age, we performed a sensitivity analysis with life expectancy and lifespan variation (1) conditional on surviving to age 5 and (2) a doubling of infant mortality prior to 1990, followed by a linear decrease to 10% higher rates in 2000, and constant inflation of 10% thereafter. These results are now included in the supplemental material and the following short description of the issued was added to the limitations section of the paper:

There could be concerns with the quality of the data used in a comparative temporal setting. First, the FSU and Central European countries used a less strict definition of live births compared to the WHO definition, which had the result of artificially depressing infant mortality levels (Aleshina and Redmond 2005, UNICEF 2003). All countries eventually shifted to the WHO definition, although the timing of this shift differed between and within countries, with some regions beginning the shift even before the dissolution of the FSU (Anderson and Silver 1986, Aleshina and Redmond 2003, UNICEF 2003). Since indices of lifespan variation are comparatively more sensitive to changes in infant mortality than life expectancy (van Raalte and Caswell 2013), we investigated whether our results would be robust to the following assumptions: (1) a doubling of infant mortality prior to 1990, followed by a linear decrease to

*10% higher rates in 2000, and constant inflation of 10% thereafter**[footnote]**, and (2) mortality conditional upon survival to age 5. While these scenarios created some differences in the direction of trends, particularly over the communist period where infant mortality decline was substantial, our two main conclusions from this period still held: (1) life expectancy and life disparity moved independently during the years before the fall of the Berlin wall, (2) trends in life disparity were especially driven by trends in early adult mortality. The results of these robustness checks are available in the online Appendix.*

Footnote: Kingkade and Sawyer (2001) published adjustment factors which were generally much lower than the doubling that we used here. Thus this adjustment should be seen as a conservative rather than realistic adjustment to test the robustness of our findings. For the 1960-1980 period, inflating the infant mortality by anywhere up to 77 % for males and 95% for females resulted in yearly changes in life expectancy and life disparity moving in unexpected directions up to 50% (see https://demographs.shinyapps.io/CEE_App/).

Results of robustness checks

Figure 1 below shows life expectancy at age 5 versus life expectancy at birth for the Eastern European countries selected in our study. Although the levels differ, major trends are like the ones we show in the paper. For instance, Russia, Latvia and Estonia also show the lower values of life expectancy at age 5, and Slovenia and Czech Republic are the frontrunners in the region after 1990 for males, even without accounting for mortality below age 5.

Similarly, Figure 2 shows life disparity or lifespan variation conditional on surviving to age 5 and at birth. As in the previous figure, the trends are similar to lifespan variation over the full age span. Figure 3 shows the association between changes in life expectancy and lifespan variation conditional on surviving to age 5 and Table 1 shows the proportions of changes in same and opposite directions. The results do not change substantively compared to those including mortality under age 5.

Figure 1. Life expectancy at age 5 for males and females. Source: HMD

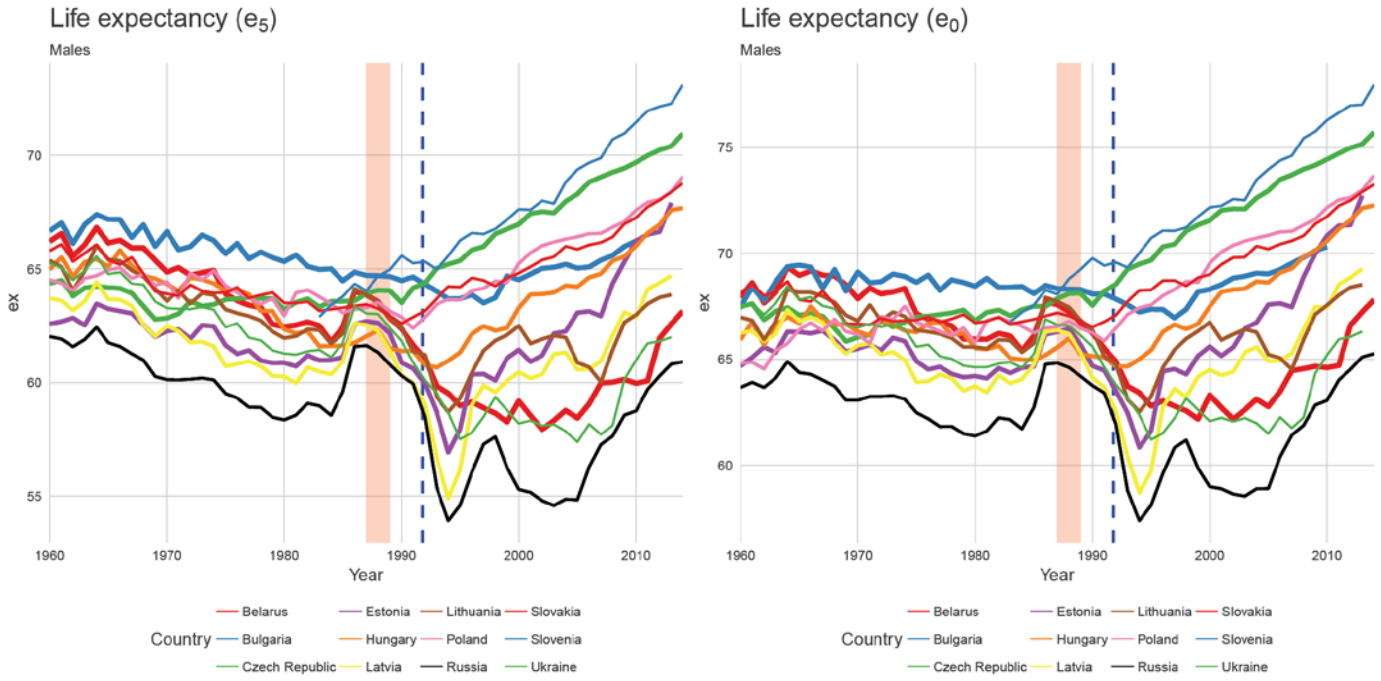


Figure 2. Life disparity at age 5 for males and females. Source: HMD

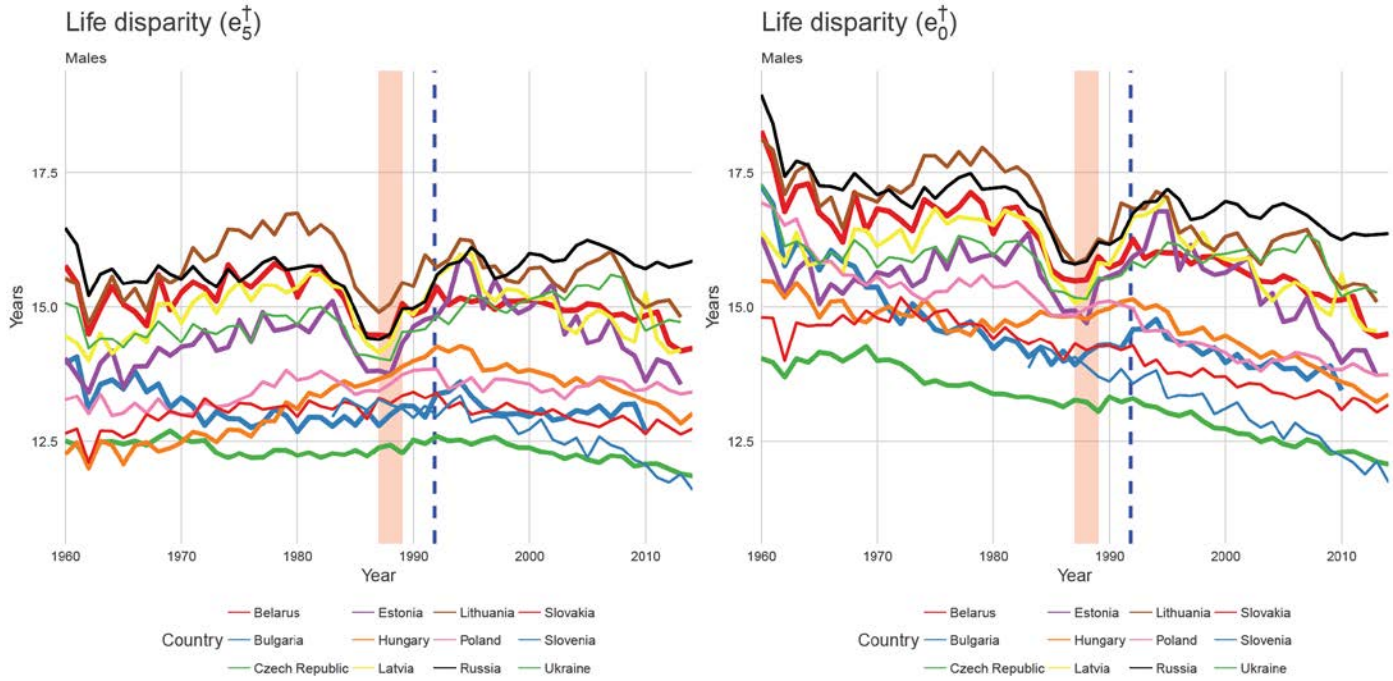


Figure 3. Association between changes in life expectancy at age 5 and lifespan variation conditional on surviving to age 5.

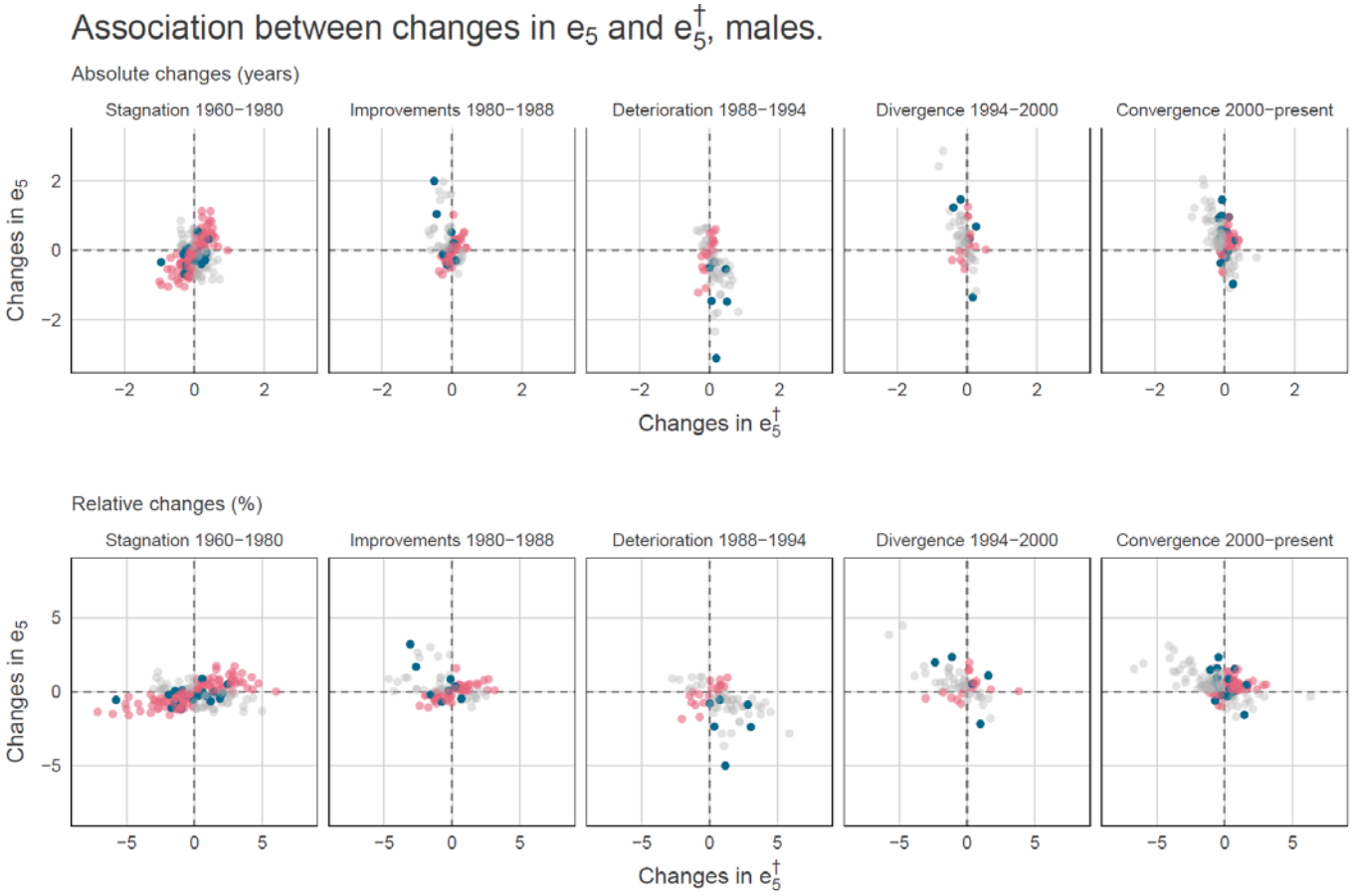


Table 1. Proportions of changes in same and opposite direction by period.

	Unexpected direction (%)	Expected direction (%)
Stagnation 1960-1980	58.6	41.4
Improvements 1980-1988	54.8	45.2
Deterioration 1988-1994	25.0	75.0
Divergence 1994-2000	31.7	68.3
Convergence 2000-present	37.2	62.8

We further performed the age-specific decomposition of lifespan variation conditional on surviving to age 5 following the same methodology that we used in the paper. Results are shown in Figure 4 below. The results are very close as if we decompose lifespan variation from age 0 (Figure 4 in the paper).

Figure 4. Age specific contributions to changes in life disparity conditional on surviving at age 5, by period.

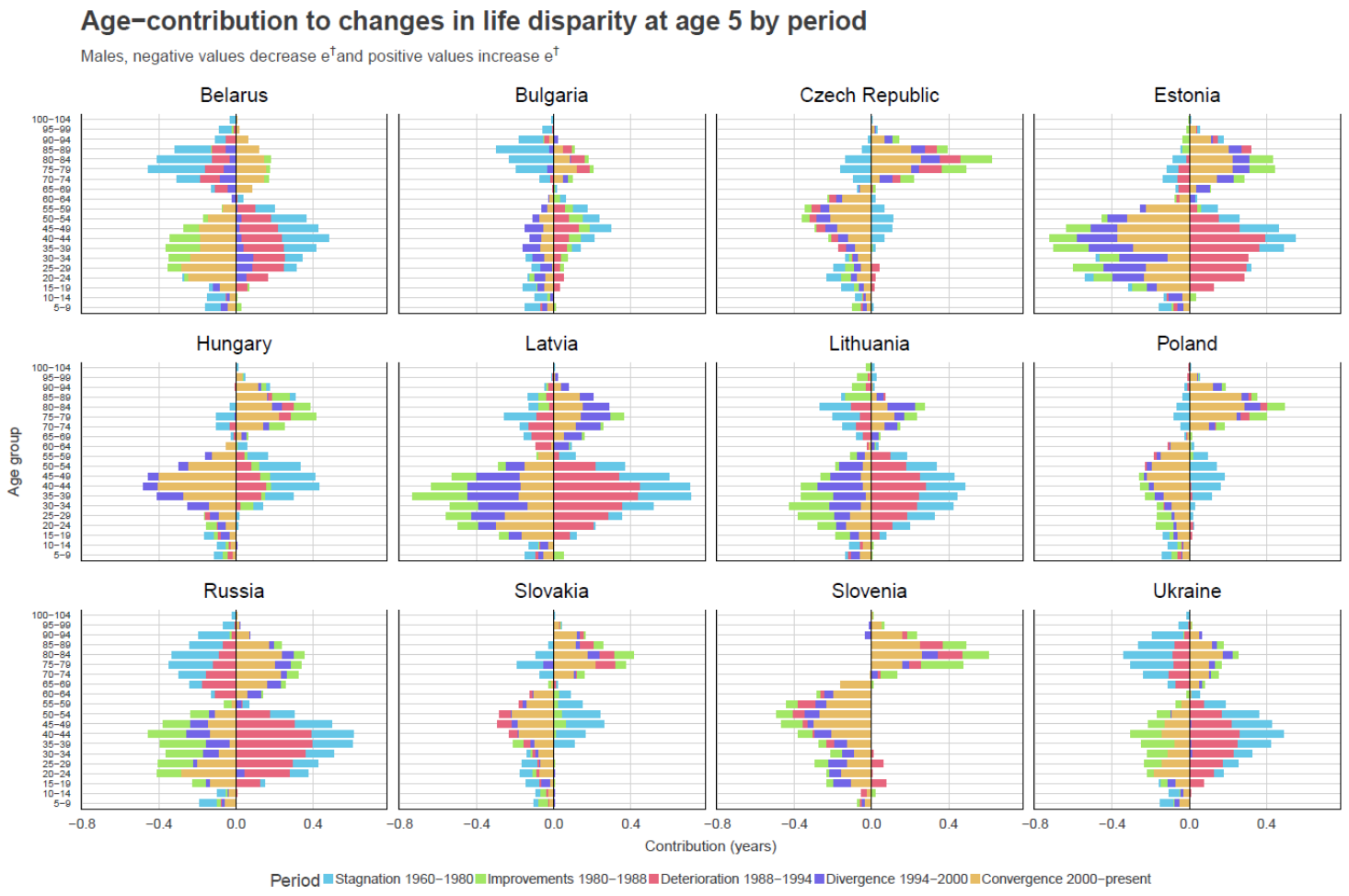
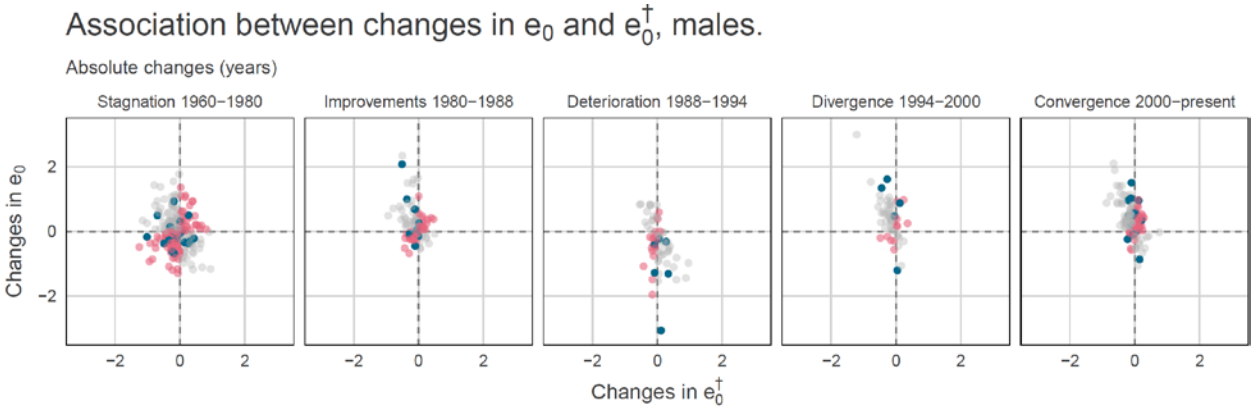


Figure 5. Association between changes in life expectancy and lifespan variation doubling infant mortality rates prior to 1990, a linear decrease to 10% higher rates in 2000, and constant inflation of 10% thereafter. Table below shows the proportions of expected and unexpected proportions.



	Expected direction (%)	Unexpected direction (%)
Stagnation 1960-1980	52.3	47.7
Improvements 1980-1988	51.6	48.4
Deterioration 1988-1994	65.3	34.7
Divergence 1994-2000	83.3	16.7
Convergence 2000-present	63.4	36.6

References

Aleshina, N., & Redmond, G. (2005). How high is infant mortality in Central and Eastern Europe and the Commonwealth of Independent States?. *Population studies*, *59*(1), 39-54.

Anderson, B. A., & Silver, B. D. (1986). Infant mortality in the Soviet Union: regional differences and measurement issues. *Population and development review*, 705-738.

Engelman, M., Canudas-Romo, V., & Agree, E. M. (2010). The implications of increased survivorship for mortality variation in aging populations. Population and Development Review, 36(3), 511-539.

Kingkade, W. W., & Sawyer, C. C. (2001). Infant mortality in Eastern Europe and the former Soviet Union before and after the breakup. US Bureau of the Census, Population Division, Washington, DC.

Unicef. (2003). Social monitor, 2003.

van Raalte, A. A., & Caswell, H. (2013). Perturbation analysis of indices of lifespan variability. Demography, 50(5), 1615-1640.

The cause-of-death analysis is too focused on the issue of alcohol. It is of no dispute that alcohol played important role in mortality fluctuations in the period and region of ex-USSR, but it has played much smaller role in central Europe (Poland, Slovakia, Czech Republic). Moreover, these countries have reduced their mortality dramatically after 1990 but the alcohol consumption levels remained the same or even increased, suggesting that alcohol had a very minor role in the recent changes (which were attributed uniquely to progress in cardio-therapy).

This is true and we made the following major changes to the manuscript.

(1) We shifted the focus away from trying to partition mortality into alcohol and non-alcohol related mortality, since attributing the proportion of mortality from amenable causes is anyway problematic. Instead in our description of the COD results we paid more attention to co-movements of circulatory disease, traffic accidents and external mortality to mortality that is wholly attributable to alcohol. This way, we can infer over which ages/periods alcohol was likely to have played a larger role in changes to these larger COD groupings.
(2) Related to the first, we were careful to point out in the results and discussion that changing alcohol patterns were not consistent with the changing COD patterns observed in Central Europe, and included a number of references from studies which had looked at other determinants such as improving medical care and changing dietary habits (Cífková 2010, Cooper 1984, Fihel and Pechholdova 2017, Zatonski 1998, Pająk and Kozela 2011, Nolte 2000a, 2000b, Rychtarikova 2004)

References

Cífková, Renata, et al. "Longitudinal trends in major cardiovascular risk factors in the Czech population between 1985 and 2007/8. Czech MONICA and Czech post-MONICA." Atherosclerosis 211.2 (2010): 676-681.

Cooper, R., Schatzkin, A., & Sempos, C. (1984). Rising death rates among Polish men. International Journal of Health Services, 14(2), 289-302.

Fihel, A., & Pechholdová, M. (2017). Between ‘Pioneers’ of the Cardiovascular Revolution and Its ‘Late Followers’: Mortality Changes in the Czech Republic and Poland Since 1968. *European Journal of Population*, *33*(5), 651-678.
Nolte, Ellen, Vladimir Shkolnikov, and Martin McKee. "Changing mortality patterns in East and West Germany and Poland. I: Long term trends (1960–1997)." Journal of Epidemiology & Community Health 54.12 (2000a): 890-898.

Nolte, Ellen, Vladimir Shkolnikov, and Martin McKee. "Changing mortality patterns in East and West Germany and Poland. II: Short-term trends during transition and in the 1990s." Journal of Epidemiology & Community Health 54.12 (2000b): 899-906.

Pająk, A., & Kozela, M. (2011). Cardiovascular disease in Central and East Europe. Public Health Reviews, 33(2), 416.

Rychtarikova, J. (2004). The case of the Czech Republic: Determinants of the recent favourable turnover in mortality. Demographic Research, 2, 105-138.

Unicef. (2003). Social monitor, 2003.

Van Raalte, A. A., & Caswell, H. (2013). Perturbation analysis of indices of lifespan variability. Demography, 50(5), 1615-1640.

Zatonski, W. A., McMichael, A. J., & Powles, J. W. (1998). Ecological study of reasons for sharp decline in mortality from ischaemic heart disease in Poland since 1991. Bmj, 316(7137), 1047.

It is also quite problematic to separate the rest of circulatory diseases from IHD and stroke, as it is known, that many Eastern countries code a large part of IHD or stroke as "atherosclerosis".

After carefully reviewing the previous version, we decided that the added value of keeping IHD separate from other circulatory diseases was low for the purposes of this study, and changing coding practices were visible for some countries in trends between these causes. Thus in the new version of the manuscript we opted to combine all circulatory disease mortality together for the reasons you describe above. We added the following to the limitations section:

"…in the Soviet era ill-defined cardiovascular diseases were often classified as 'atherosclerotic cardiosclerosis', which is a subset of ischemic heart diseases (Jasilionis et al. 2011, Shkolnikov 2012). Different countries abandoned this practice at different rates, which had the effect of misclassifying deaths between the IHD, stroke and other circulatory disease categories. While some degree of misclassification within circulatory disease is corrected for by the HCD team (Pechholdova et al. 2017), for comparative purposes we felt it safer to combine all circulatory disease categories."

References:

Jasilionis, D.; Meslé, F.; Shkolnikov, V. M. & Vallin, J. (2011). Recent Life Expectancy Divergence in Baltic Countries. *European Journal of Population / Revue européenne de Démographie, 27*, 403

Pechholdová, M., Camarda, C. G., Meslé, F., & Vallin, J. (2017). Reconstructing Long-Term Coherent Cause-of-Death Series, a Necessary Step for Analyzing Trends. European Journal of Population, 1-22.

Shkolnikov, V., Meslé, F., & Vallin, J. (2012). Data Collection, Data Quality and the History of Cause-of-Death Classification. In *Mortality and Causes of Death in 20th-Century Ukraine* (pp. 121-130). Springer, Dordrecht.

In the decomposition analyses (by age), it is likely that positive contributions of the elderly to the mortality compression can be linked to poor data quality in the ex-USSR and Bulgaria in the 1960s (underestimation of old-age mortality leading to artificial worsening afterwards). This should be mentioned in the discussion/limitations.

Thank you for the suggestion. While this might explain some of the between-country differences in levels of mortality increase, the overall trends of mortality increase was also a feature in central European countries, thought to have better quality old age data during the 1960s. To our knowledge a comprehensive assessment of the magnitude of bias this might have caused throughout the region has not been undertaken. For this reason we did not do any robustness checks on old age data, but instead added the following paragraph to the limitations:

Second, the HMD data used in this project is the highest quality and most comparable data available for the region. However, the data quality differs between countries, age groups and periods, and is well documented in the database. The main data quality concerns which have been flagged in the region include: age heaping and likely age exaggeration in many FSU countries and Bulgaria in the 1960s (Grigoriev 2017, Jasilionis 2017a, Jdanov & Shkolnikov 2017, Pyrozhkov et al. 2017, Philipov and Jasilionis 2017); lower quality data above age 80 in Belarus in the 1970s (Grigoriev 2017) and Russia after the mid-1990s (Jdanov & Shkolnikov 2017); and consistency problems in population estimates in Lithuania for the 1960s and 1970s (Jasilionis & Stankukiene), in Estonia during the 1990s (Jasilionis 2017b) and in Slovenia (Jasilionis 2017c). Age heaping is less of a problem for life table summary measures, but age exaggeration is difficult to correct for and could have led to artificially worsening mortality at older ages as data quality improved. While a degree of caution should be applied in interpreting mortality differences and trends for these periods, age groups and countries, even if we were to exclude all instances of these flagged problems, the broader patterns of mortality development that we document here still hold.

References:

Grigoriev, P. (2017). About mortality data for Belarus. Human Mortality Database: Background and Documentation. *University of California, Berkeley and Max Planck Institute for Demographic Research, available at: http://www.mortality.org/*

Jasilionis, D. (2017a). About mortality data for Latvia. Human Mortality Database: Background and Documentation. *University of California, Berkeley and Max Planck Institute for Demographic Research, available at: http://www.mortality.org/*

Jasilionis, D. (2017b). About mortality data for Estonia. Human Mortality Database: Background and Documentation. *University of California, Berkeley and Max Planck Institute for Demographic Research, available at: http://www.mortality.org/*

Jasilionis, D. (2017c). About mortality data for Slovenia. Human Mortality Database: Background and Documentation. *University of California, Berkeley and Max Planck Institute for Demographic Research, available at: http://www.mortality.org/*

Jasilionis, D. , & Stankuniene, V. (2017). About mortality data for Lithuania. Human Mortality Database: Background and Documentation. *University of California, Berkeley and Max Planck Institute for Demographic Research, available at: http://www.mortality.org/*

Jdanov, D.A. and Shkolnikov, V.M. (2017) About mortality data for Russia. Human Mortality Database: Background and Documentation. *University of California, Berkeley and Max Planck Institute for Demographic Research, available at: http://www.mortality.org/*

Philipov, D and Jasilionis, D (2017) About mortality data for Bulgaria. Human Mortality Database: Background and Documentation. *University of California, Berkeley and Max Planck Institute for Demographic Research, available at: http://www.mortality.org/*

Pyrozhkov, S., Foygt, N., & Jdanov, D. (2017). About mortality data for Ukraine. The Human Mortality Database: Background and documentation. *University of California, Berkeley and Max Planck Institute for Demographic Research, available at: http://www.mortality.org/*.

In the Limitations section, the author discusses several approaches to the measurement of alcohol mortality effects. This limitation could be avoided if authors gave less importance to the alcohol as the main (and only) factor for past and recent mortality changes in Central and Eastern Europe.

We thank the reviewer for her/his suggestion. Given the perceived importance of changing hazardous alcohol consumption patterns in many countries of the region, we still felt that it was necessary to discuss the difficulties in attributing mortality to alcohol in the limitations section However, we also broadened the manuscript to explicitly add other explanations to past and recent mortality changes in Central and Eastern Europe. The changes were as follows:

Cause-of-death subsection in discussion:
"Fluctuating alcohol-related mortality was an important component of the moving life disparity trends in the countries of the former Soviet Union, although it occurred to different degrees in each region, and manifested itself in different causes. Over young ages, a large role was found for the reduction of external cause mortality including traffic accidents in the Baltic countries throughout the period, and in Russia, Belarus and Ukraine from 2000 onwards. Since these causes often co-moved with mortality directly attributable to alcohol over these ages it is suggestive that healthier patterns of alcohol consumption were contributing to these reductions in life disparity. At older ages, between-country differences in mortality reduction seemed to be driven by the extent of mortality reduction from circulatory diseases. In addition, alcohol consumption is not the only factor that explains mortality trajectories in the region, or the sole explanation for difference between life expectancy and lifespan variation levels with western European countries. Other factors, such as environmental pollution, medical care, smoking behaviors and diet have been important determinants of health outcomes in this region since at

least 1970 (Bobak and Marmot 1996). Indeed, the strong declines in circulatory disease mortality in the Baltic countries (Jasilionis et al. 2011), and more recently Russia (Grigoriev et al. 2014) have been seen as hopeful signs that these countries are finally on a path toward the lower levels of cardiovascular mortality that have been achieved in the west.

In contrast to the Baltic and other FSU countries, the smoother trends in life disparity found in Central Europe were driven by sustained declines in circulatory disease and cancers, with external causes playing a much smaller role, and no change in mortality directly attributable to alcohol. This is consistent with others who have argued that the steady post-1990 improvements in mortality in the region were attributable to a combination of improvements in medicine, a reorganization of the health care system, and general shifts toward healthier behavior including improving diets and reductions in smoking (Pajak and Kozela 2011, Zatonski et al. 1998, Fihel and Pechholdov_a 2017, Cifkova et al. 2010, Cooper et al. 1984, Rychtarikova 2004, Nolte et al. 2000a;b)."

Discussion. In order to downplay the examination exclusively of alcohol-attributable mortality, we replaced the sentences: "*we used high quality comparably reconstructed cause of death data to analyze the role of alcohol-related mortality on changing lifespan variation based on a reflective classification*" with:
"*we looked into the causes of death that were responsible for the major changes in lifespan variation in the region*."

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I would like to see a bigger discussion on the added value of the lifespan dispersion indicators. It seems that if lifespan inequality is measured across the entire age range, its value depends on two processes: premature and old-age mortality, and mortality compresses or expands when these two processes move in opposite directions (and how they balance in the summary measure). The allegedly unexpected results for Central and Eastern Europe are thus rather witnesses of different sensitivity of e0 and e-dagger to mortality age-patterns.

In page 15, we complemented the paragraph preceding the age-specific contributions to stress the added value of lifespan variation as an indicator in population health studies. It now reads:

"From a public health perspective, these results are important because they disclose inequalities underlying population health that could not be identified by looking at life expectancy alone. As previously noted, the full distribution of deaths is characterized not only by the mean (life expectancy), but also by how disperse ages at death are (Edwards and Tuljapurkar 2005). Therefore, increasing lifespan variability underscores the rise in within-group heterogeneity and the uncertainty that people face regarding their age at death."

We complemented the concluding paragraph and now the first two sentences read:

"*Lifespan variation, in this case* $e^{\dagger}$*, is a measure of aggregate health inequality that reveals fundamental differences in levels and trends across the countries that we studied. Therefore, analyzing lifespan dispersion together with life expectancy contributes to a deeper understanding of the impact of changing mortality trends on population health…"*

We also include a subsection in the discussion named “Age-specific contributions to changes in $e^{\dagger}$", in this subsection we included the next sentence:

“*Life expectancy increases with mortality improvements at all ages. However, lifespan variation increases or decreases depending on the balance of saving lives at ``younger ages'', which compresses mortality into a smaller age interval and at ``older ages'' where saving lives leads to greater variability (Zhang and Vaupel 2009, Gillespie et al. 2014). These properties indicate that life expectancy and lifespan variation have different sensitivities to mortality changes over the age-span (van Raalte and Caswell 2013). Thus, lifespan variation, when measured across the entire age range, depends on two processes: premature and old-age mortality. Mortality compresses or expands, depending on the balance between these two processes. Our results for Central and Eastern Europe, which run counter the western narrative, are a product of different sensitivity of life expectancy and lifespan variation to mortality age-patterns.* ”

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