The recent evolution of mortality across Europe

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Background

Against some expectations that theorized a limit to human life span, humans are breaking limits to life expectancy (Oeppen and Vaupel, 2002). Following the authors, if the most part of the gain in life expectancy was due to huge reductions in mortality at younger ages, after this period, in the second half of the century, were the improvements in survival after age 65 that contributed to an extension in the life span.

These contributions are result from an *"intricate interplay of advances in income, salubrity, nutrition, education, sanitation, and medicine"*, or to sum up, the result of large improvements in human health, *"with the mix varying over age, period, cohort, place, and disease"* (Riley – 2001, quoted in Oeppen and Vaupel, 2002). Vaupel in 2010 wrote in his Nature paper that *"mortality is by far the most important readily and reliably measured index of health"*, and the truth is that the world's life expectancy rose more than the double in the last centuries due to low levels of mortality observed at all ages.

So, and always looking to mortality behaviours after age 65, we compare the recent evolution of mortality and aging patterns across some selected European countries based on two of the most used measures to analyse mortality patterns:

- ✓ The *force of mortality*;
- ✓ And, the *life table aging rate* (LAR).

Some results

Fig. 1: Estimated Rate of Aging for the selected countries

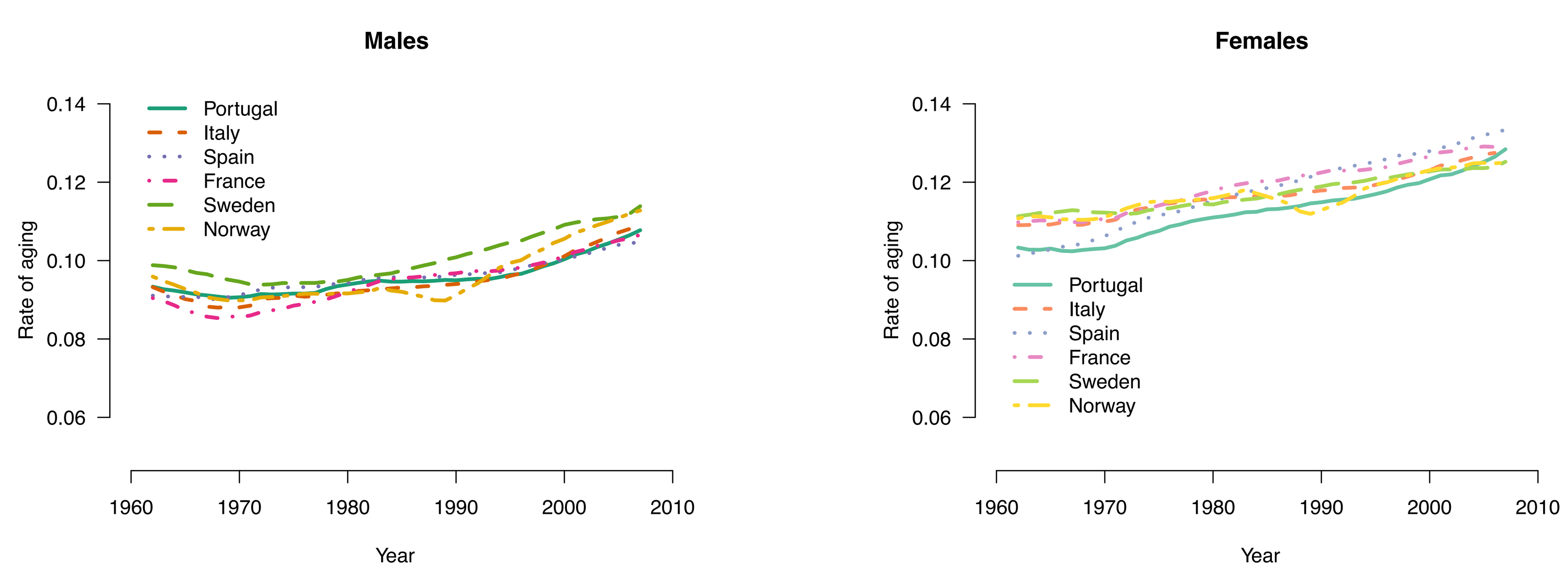


Fig. 2: Estimated Life Table Aging Rate for Portugal

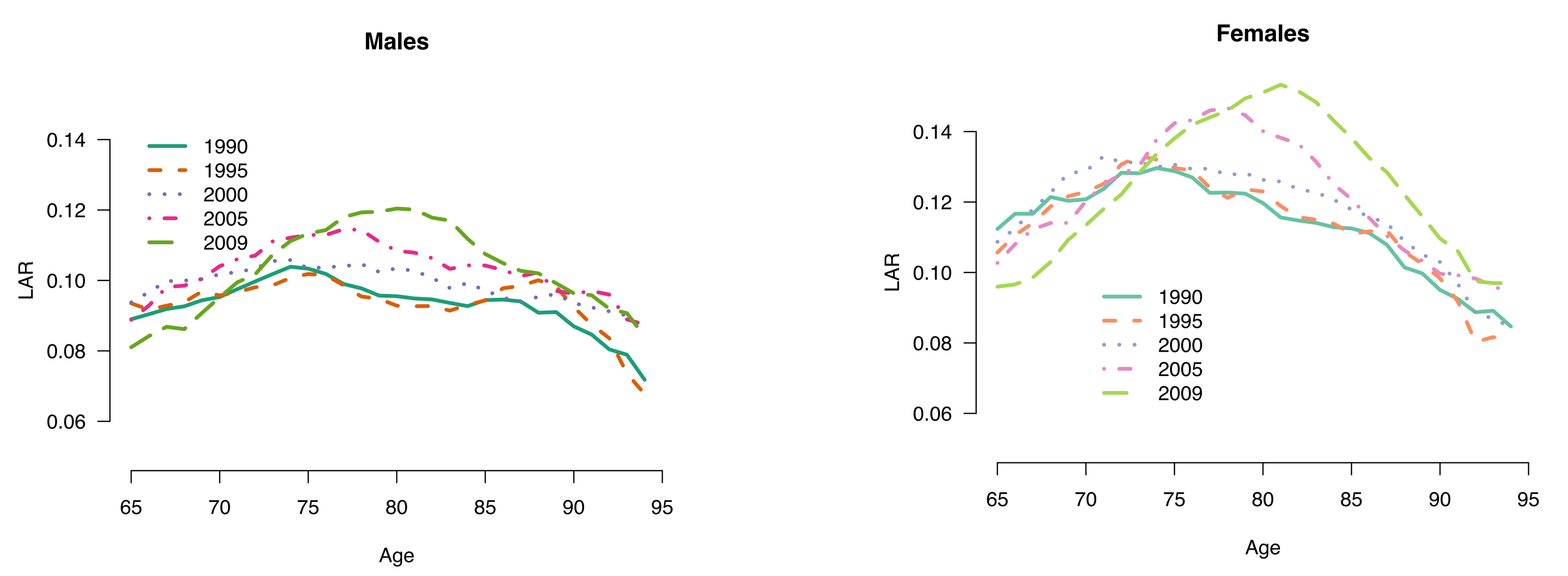
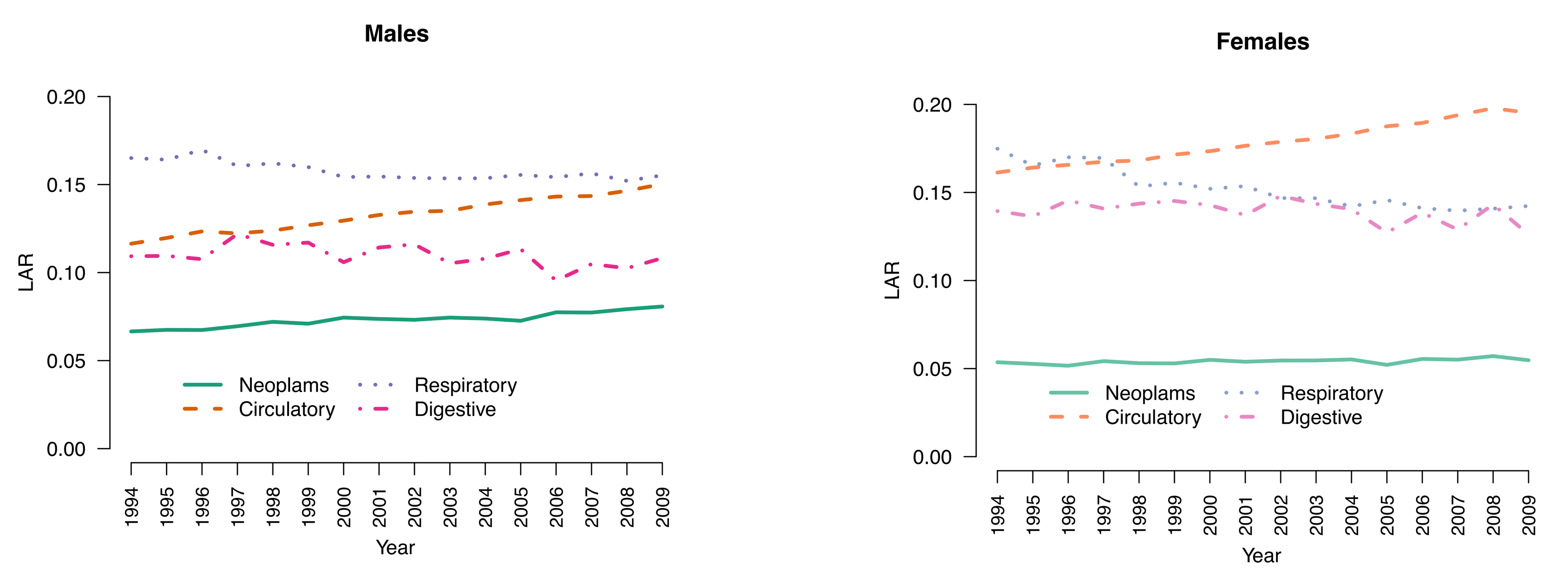


Fig. 3: Estimated Rate of Aging for Sweden for selected causes of death



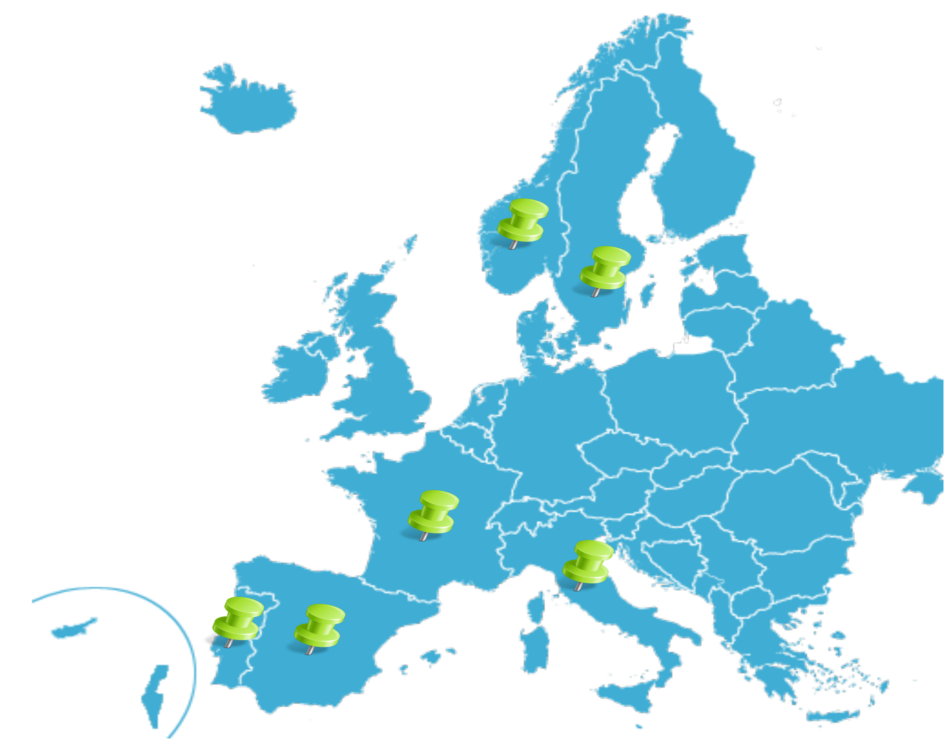
***Figures 1 to 3:** EUROSTAT, Human Mortality Database, authors own calculation

Data and methods

① **Data:**

✓ The data was collected separately by sexes, ages, and causes of death. The period varies between 1960 and 2010 for the total death counts, and between 1994 and 2009 for cause of death data. Six different countries were taken into account:

- ❖ Portugal;
- ❖ Spain;
- ❖ France;
- ❖ Italy;
- ❖ Sweden;
- ❖ Norway.



② **Force of mortality:**

$$\mu_x = -\frac{1}{l_x}\frac{dl_x}{dx} = -\frac{d}{dx}\ln l_x$$

- Here estimated using the *Gompertz* law of mortality:

$$\mu_x = ae^{bx}$$

③ **Life Table Aging Rate:**

$$k(x) = \frac{1}{\mu_x}\frac{d\mu_x}{dx} = \frac{dln(\mu_x)}{dx}$$

Conclusion & discussion

1. As expected, the achieved results for the Life Table Aging rate followed a ***bell-shaped*** pattern for both sexes and a shift of the highest values to older ages over the years. The highest values are attained earlier in males than in females;
2. The law of mortality developed by ***Gompertz*** fits better to the overall population than when is applied to each cause of death separately, however, the results show that women have, generally, a higher rate of aging than males, but a smaller level of mortality at the starting age;
3. Deaths by ***neoplasms***, on the other hand, from the selected causes of death, are the ones that present the lowest rate of aging, however with the highest level of mortality at the starting point;
4. Both, the ***LAR*** and the ***rate of aging***, and as expected, allow to observe that there are two main groups between the selected countries. One that includes France, Portugal, Spain and Italy, and another one for Sweden and Norway;
5. Although that ***LAR*** was taken as a better measure for the pace of increase in mortality with age, it can be seen empirically that these two are different (as was proved by Vaupel & Zhang, 2010);
6. Despite the obtained results, it should be said that the overall population is composed by different heterogeneous sub-groups, and that was not taken here into account. Nevertheless, is our goal to include unobserved heterogeneity in the used models in future calculations to obtain better results.

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