A non-parametric approach to decompose the young adult mortality hump by causes of death

Motivation

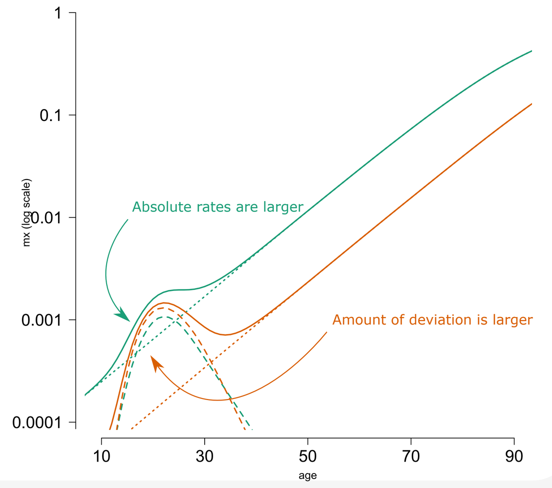
▸ Young adult morality hump = temporary deviation in the force of mortality

▸ Should be measured by the amount of deviation from senescence, not the absolute death rates

▸ Cause-of-death contributions are not established

▸ Same causes responsible for gender-specific humps?

▸ Cause-specific contribution = how much the hump decreases after deleting each cause



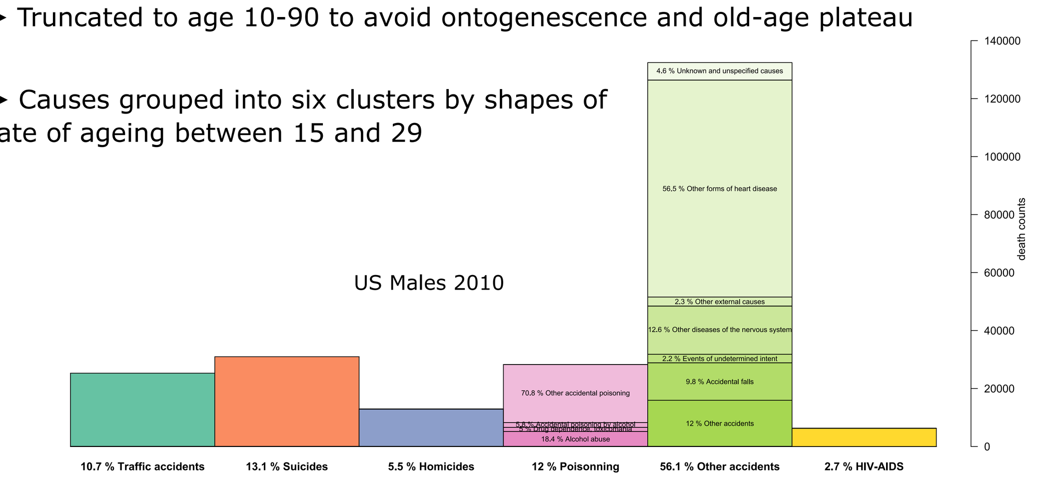
Data

▸ Age-, sex- and cause-specific death rates for the United States (1959 - 2010)

▸ Early release of new HMD cause-of-death data (cod.mortality.org)

▸ Truncated to age 10-90 to avoid ontogenescence and old-age plateau

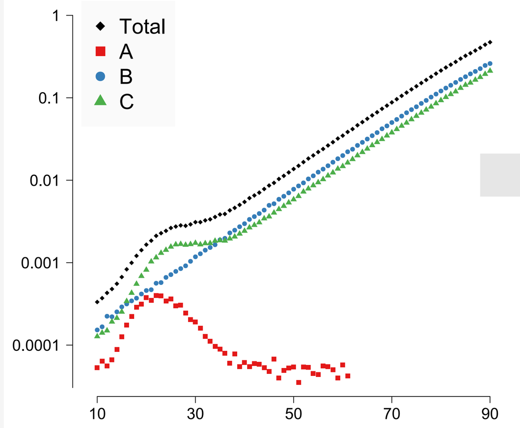
▸ Causes grouped into six clusters by shapes of rate of ageing between 15 and 29



Method
with toy example

Identify causes contributing to the hump → Non-parametric decomposition of overall hump → Simultaneous re-fitting of cause-deleted hump → Extract cause-specific hump contributions

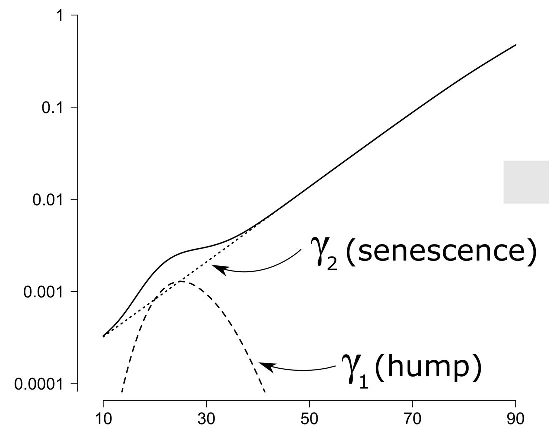
Cause- and age-specific rates



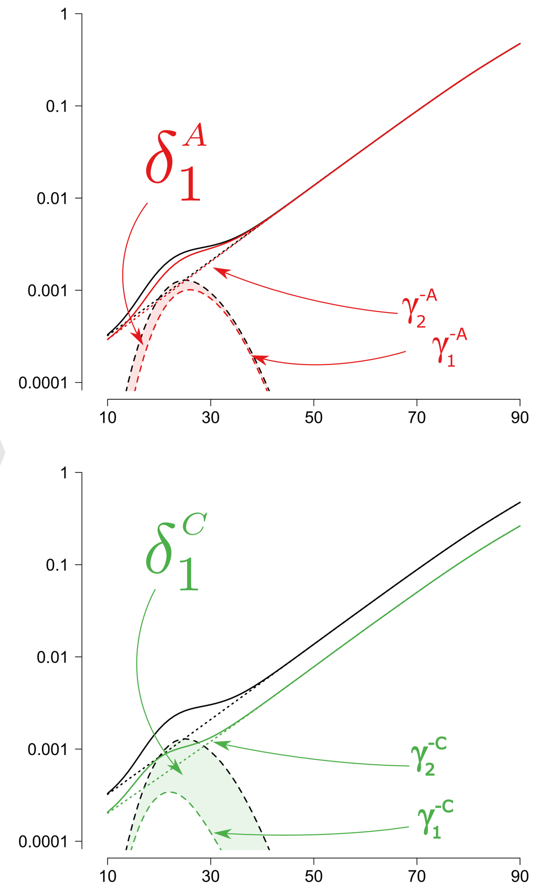
$$y \sim \mathcal{P}(\mu \cdot e = (\gamma_1 + \gamma_2) \cdot e)$$

(Camarda et al., stat. model., 2016)

All-cause mortality



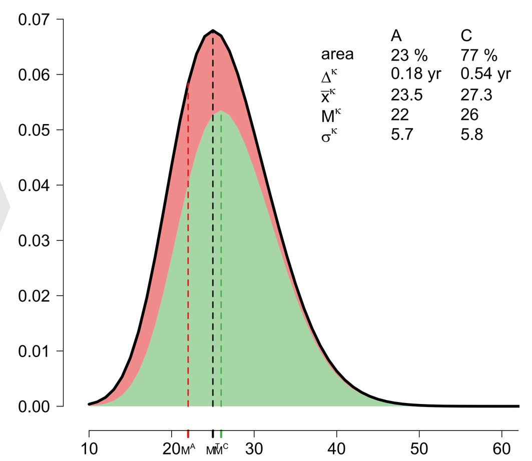
Cause-deleted mortality



$$\begin{cases} y^{-\kappa} \sim \mathcal{P}((\gamma_1^{-\kappa} + \gamma_2^{-\kappa}) \cdot e) & \forall \kappa \in \{A, C\} \\ \hat{y}_1 = e \cdot (\delta_1^A + \delta_1^C) & \delta_1^\kappa = \gamma_1 - \gamma_1^{-\kappa} \\ \hat{y}_2 - \hat{y}^B = e \cdot (\delta_2^A + \delta_2^C) & \delta_2^\kappa = \gamma_2 - \gamma_2^{-\kappa} \end{cases}$$

Poisson distribution; cause-deleted deaths; cause-deleted components; exposures; overall hump-attributed deaths; overall senescence-attributed deaths; deaths from causes w/o hump; cause-specific contributions to senescence; cause-specific contributions to the hump

Density of the hump



$$\begin{aligned} Area &= \int_0^\omega \delta_1^\kappa(x)dx \\ \Delta^\kappa &= e_{10}^{-\delta_1^\kappa} - e_{10} \\ \bar{x}^\kappa &= \frac{\int_0^\omega \delta_1^\kappa(x) \cdot x dx}{\int_0^\omega \delta_1^\kappa(x)dx} \\ M^\kappa &= \arg\max_x \delta_1^\kappa(x) \\ \sigma^\kappa &= \sqrt{\frac{\int_0^\omega \delta_1^\kappa(x) \cdot (x - \bar{x}^\kappa)^2 dx}{\int_0^\omega \delta_1^\kappa(x)dx}} \end{aligned}$$

USA 1959-2010

Lexis surfaces of hump-related rates

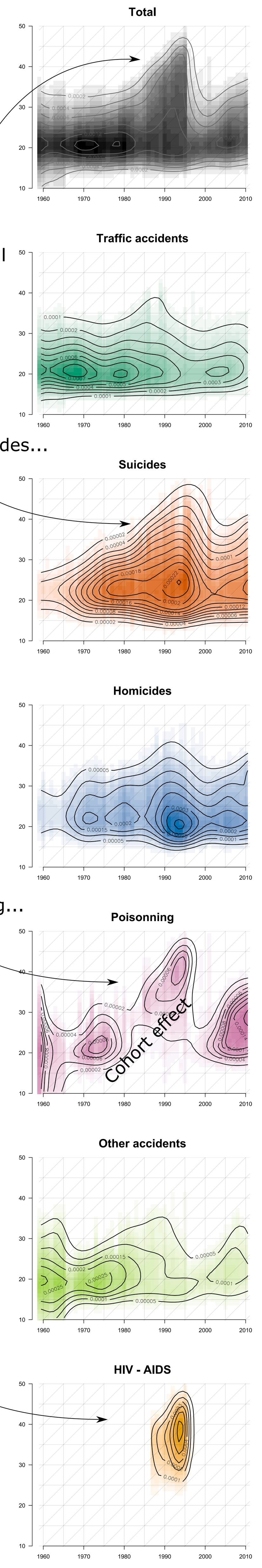
Males | Females

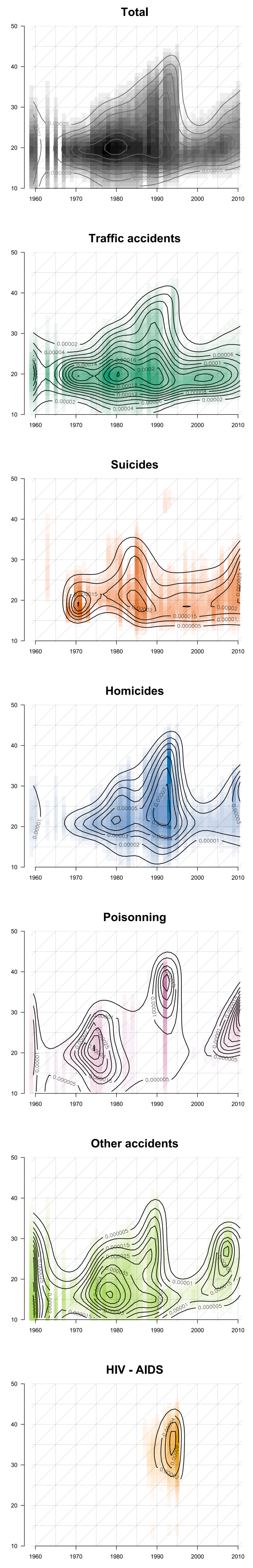
widening of overall hump due to...

...widening of suicides...

... shift of poisoning...

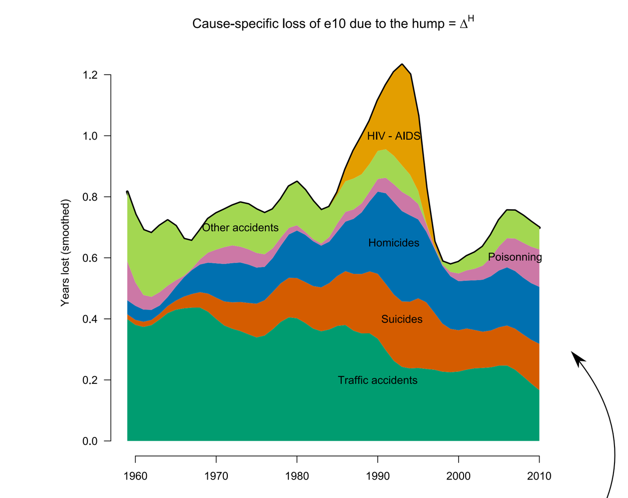
... and HIV

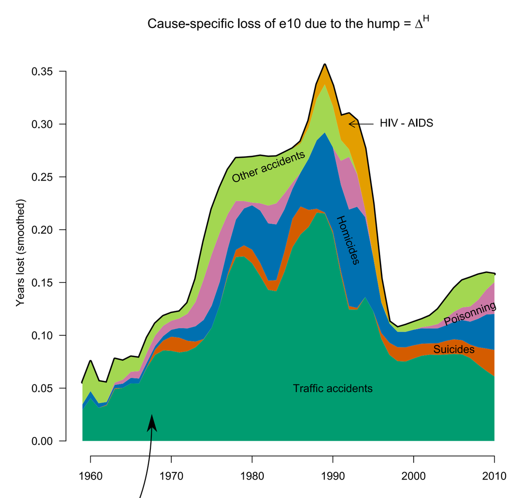




Summary measures

Males | Females

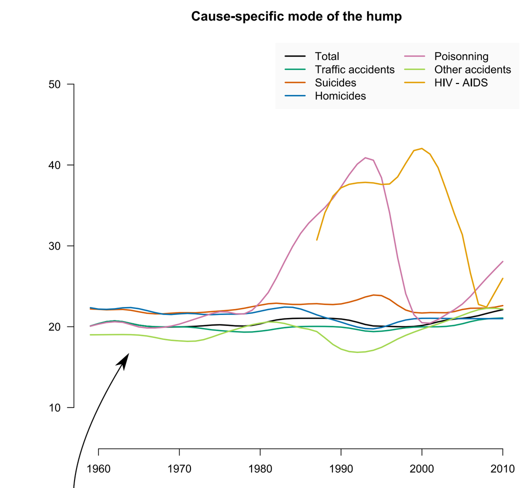


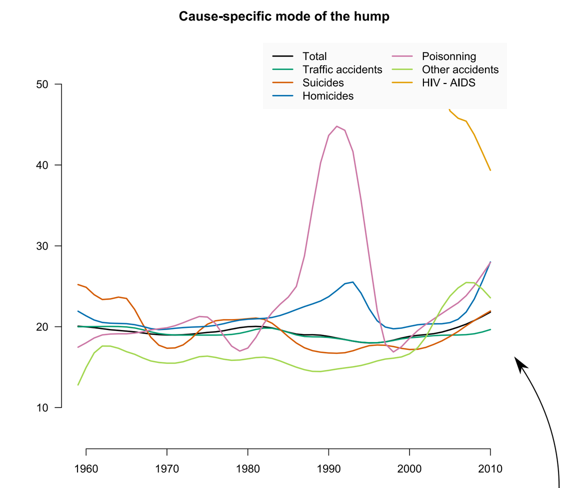


over two thirds suicides, homicides and poisoning

virtually no hump

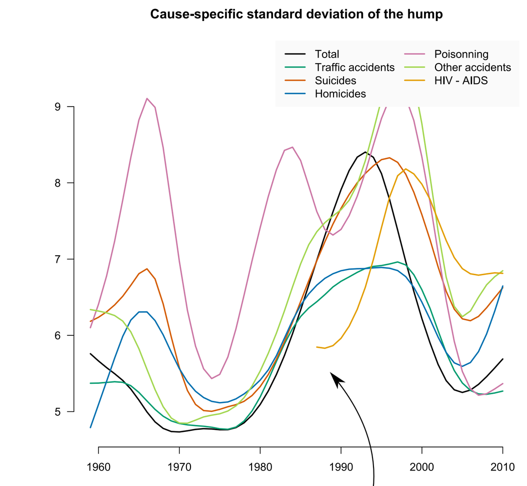
mainly driven by traffic accidents (corr = 0.84)

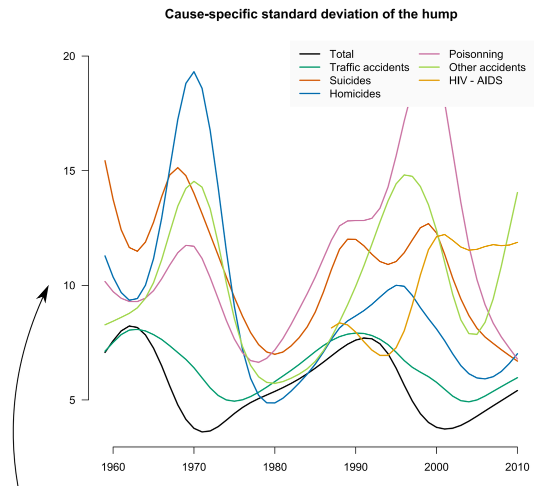




stable peak except for poisoning

recent shift to older ages





general widening in the 1980s

larger spread for females

Adrien Remund
Institut national d'études démographiques
Université de Genève
adrien.remund@unige.ch

Tim Riffe
Max Planck Institute for Demographic Research
riffe@demogr.mpg.de

Carlo Giovanni Camarda
Institut national d'études démographiques
carlo-giovanni.camarda@ined.fr

This work has benefited from the financial support of

Modicod : "Le projet AXA Mortality Divergence and Causes of Death"
Dimocha : "Project ANR-12-FRAL-0003-01 DIMOCHA"

Early Postdoc scholarship from the Swiss National Science Fundation

Bourse post-doctorale Eugène Choisy et Charles Borgeaud from the Société Académique de Genève

Conclusion

Method

▸ Gives coherent results

▸ Proves adaptive to changing context

▸ Will be made available in a R package

New research questions

▸ Which underlying forces drive the hump?

▸ Will accidents eventually stop contributing?

▸ How much is the hump a cohort artifact?

▸ What happens if we go further back in time?

▸ How do the US compare to other countries?

▸ Is excess mortality premature mortality?

▸ How does the hump relate to e-dagger?

▸ How does the hump relate to YLL?