Investigating mortality data

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Possible metrics (and their problems)

- Reported case numbers
- Reported deaths
- Deaths according to death certificates

Excess mortality: a definition

- The difference between the actual mortality of a time period (*observed* mortality) and the mortality of the same period when forecasted from past data (*expected* mortality)
- Rationale: the mortality-modifying event is not present in the past data, so forecasting from them gives a "what-if" data (counterfactual) on what would have been the case without epidemic
- Thus the difference, i.e., the excess mortality represents the effects of the pandemic
- (The method is not specific to epidemics, in fact, it is often used for natural disasters in developing countries)

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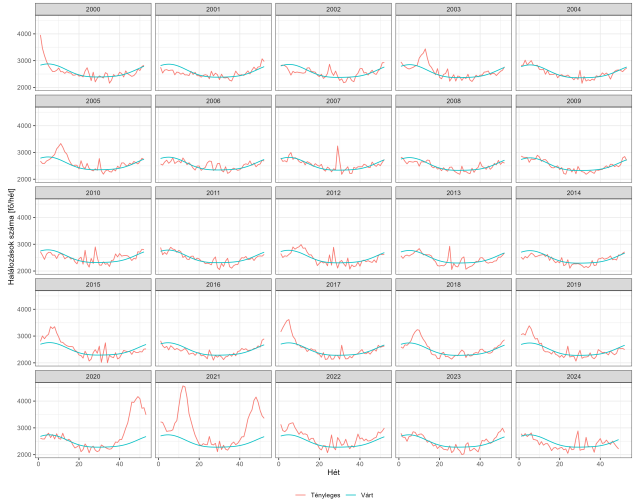
Excess mortality: an illustration



Excess mortality: pros and cons

- Pro
  - Now, it is *really* insensitive to testing activity
  - Now, it is *really* insensitive to cause-of-death classification
- Con
  - Very slow (usually published with 4-6 weeks of delay, even that is sometimes revised in the next few weeks)
  - Gross indicator: "effects of the pandemic" actually includes *all* direct and indirect effects – both positive and negative – of the epidemic and its handling
  - Requires an estimation of the baseline, subject to forecasting error

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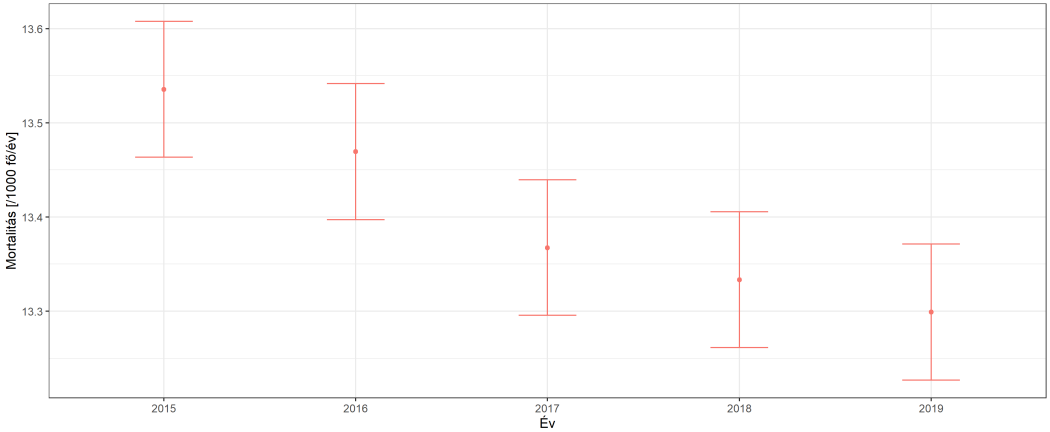
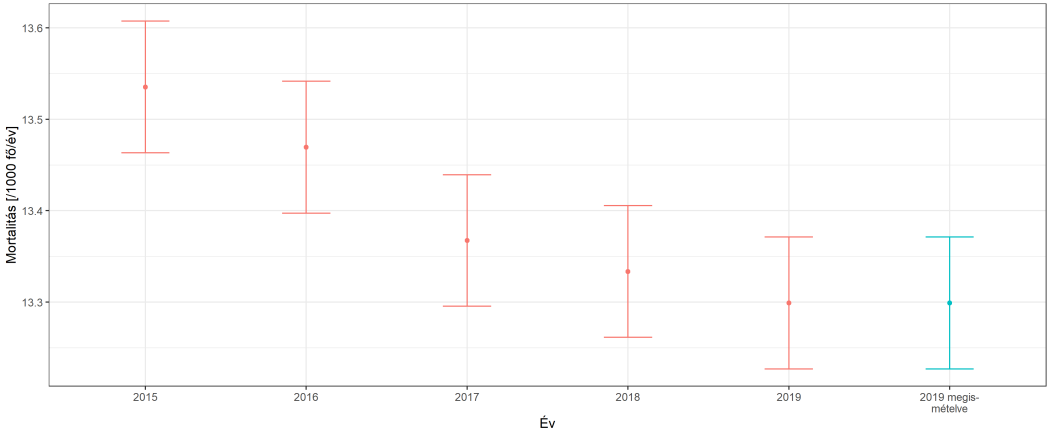
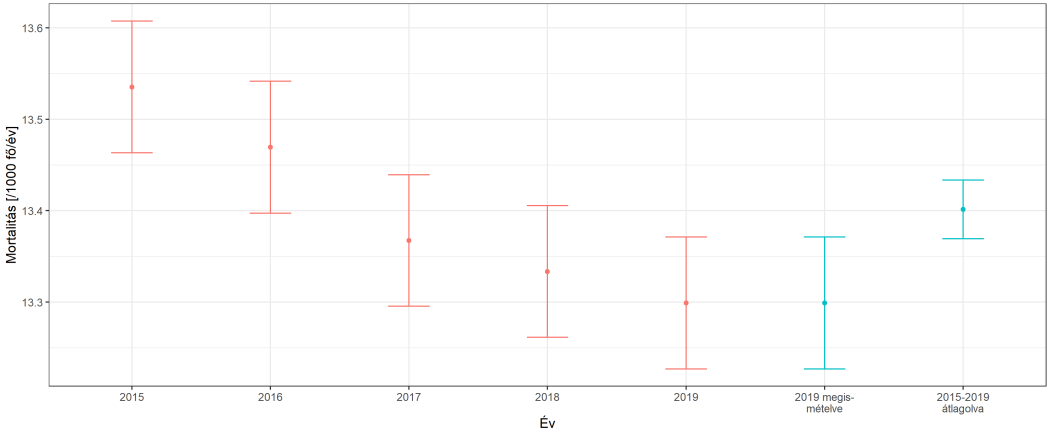
An example country



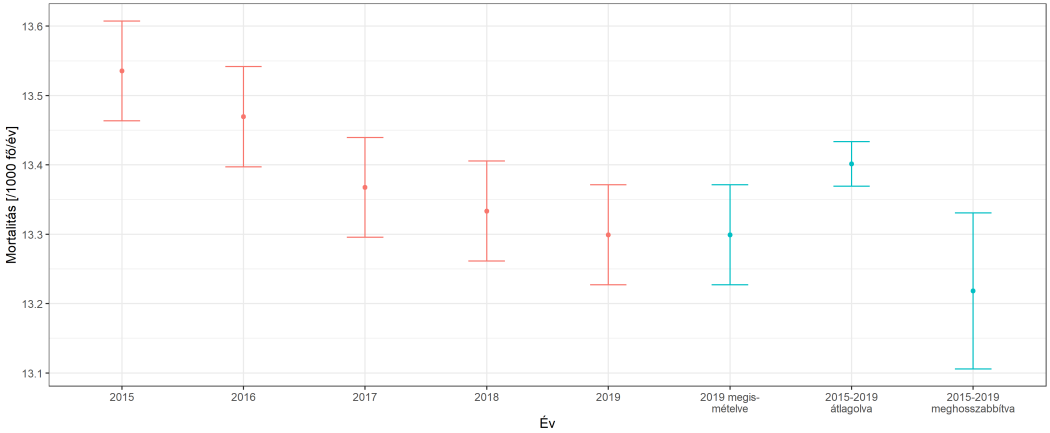
Last year carried forward



The average of the last few years



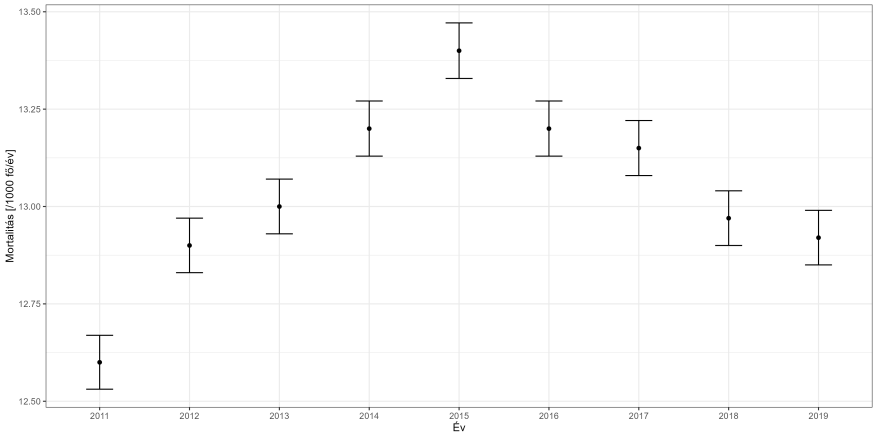
Linear extrapolation based on the last few years



Some conclusions

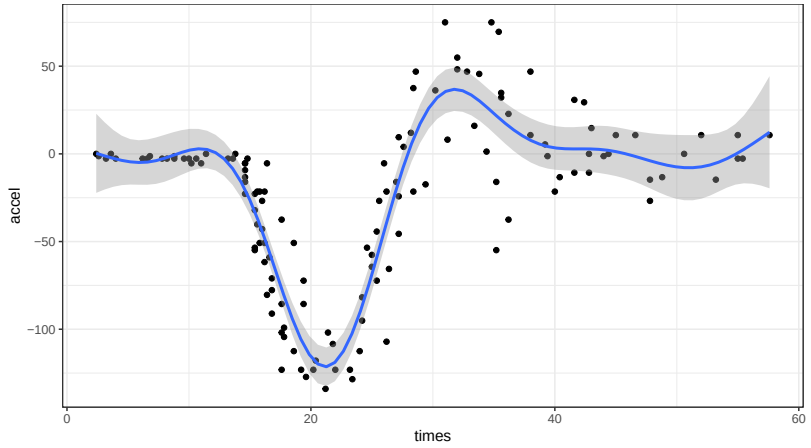
- The method matters...
- ...especially given that the subtraction will magnify errors (let's say the observed value is 1,000 deaths, then an expected of 990 vs. 900, a 10% difference, gives rise to an excess mortality of 10 vs. 100 respectively, a 100% difference!)
- Variance-bias trade-off

Even linear extrapolation is not straightforward: where to begin?

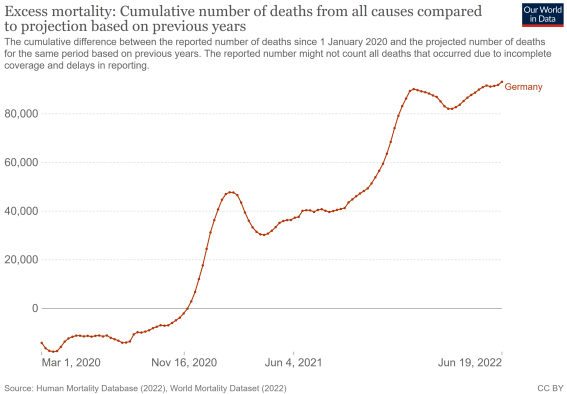


The best (?) solution therefore: using splines

A logical idea, but...

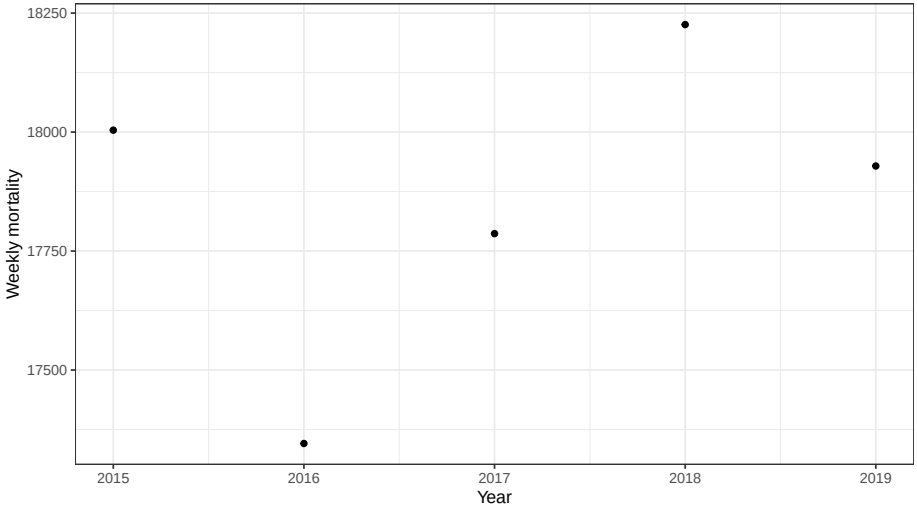


"The German Puzzle"



Compared to that, the estimate of the WHO presented on May 5, 2022 was 195,000!

„The German Puzzle”



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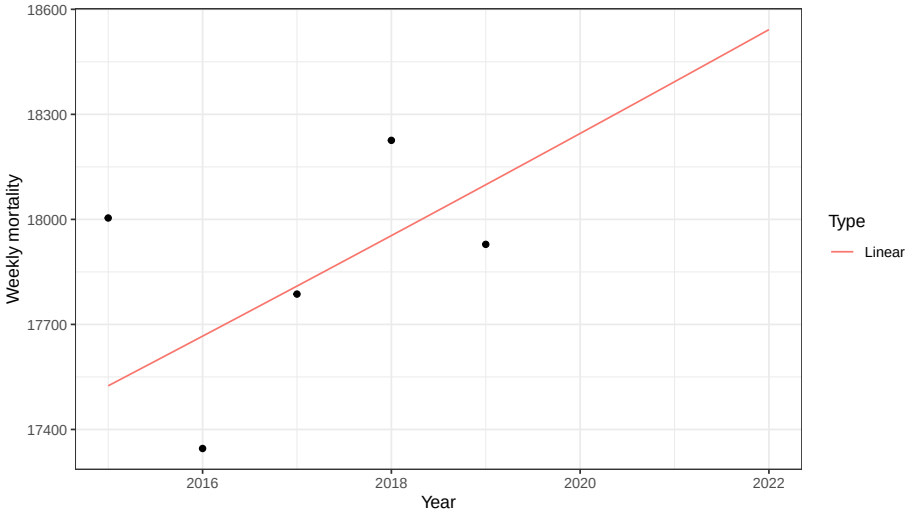

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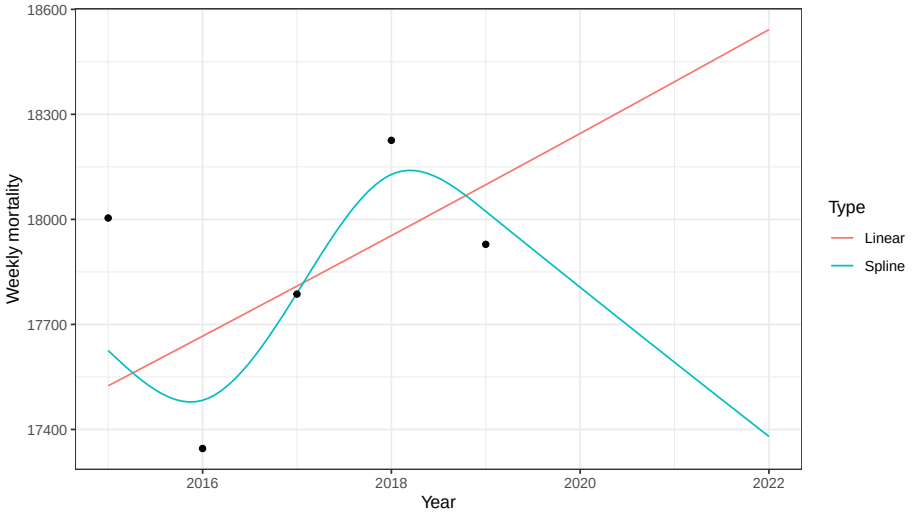

Our work

- We carried out an empirical study (extensive simulation using synthetic datasets)
- To clarify whether the usage of splines was the culprit *per se*
- What properties – both of the data and of the method – gave rise to this problem?
- Based on this, what is the best method (and parametrization) to use?
- Published results: T Ferenci. Comparing methods to predict baseline mortality for excess mortality calculations. BMC Med Res Methodol. 2023 Oct 18;23(1):239. doi: 10.1186/s12874-023-02061-w.
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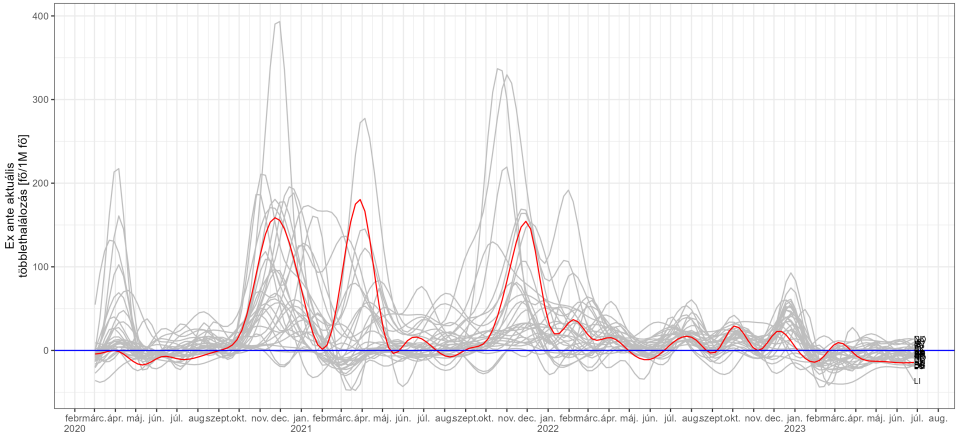
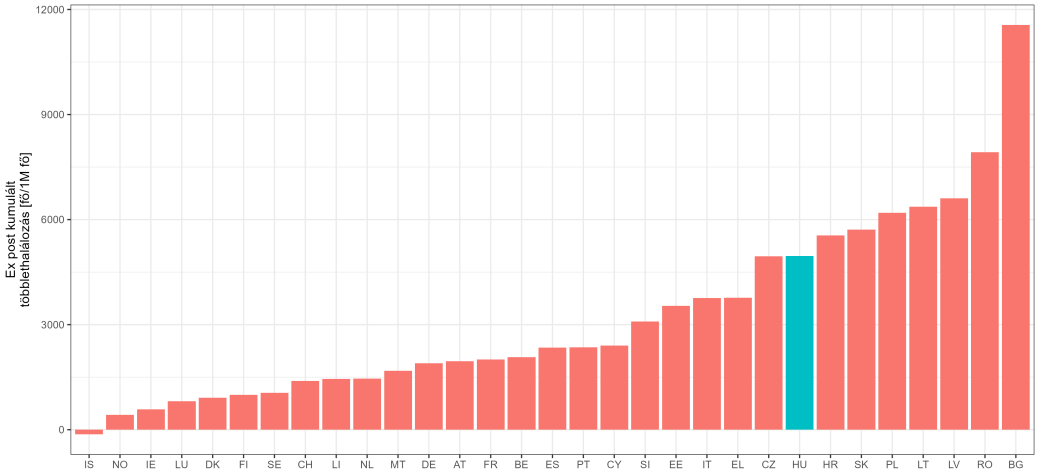
Ex ante results during the epidemic



Ex post snapshot at the end of the epidemic



Ongoing monitoring

- The whole process described above has been implemented in one, single informatics pipeline (using R)
- Available at `github.com/ferenci-tamas/ExcessMortEUR/`
- Capable of continuous, automatically updated monitoring via CI/CD

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Rationale

- Causes of deaths, even with their limitations, are relevant for public health analysis
- They are publicly available through the WHO
- So here the problem is not really monitoring, but rather the interpretation and dissemination of the results
- But we developed a portal to facilitate this!

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Ongoing monitoring

Available at `https://research.physcon.uni-obuda.hu/OkspecifikusMortalitasiAdatbazis/`

Thanks for your attention!