Comparing approaches in modelling 2020 overall mortality by sex and age

Carlo Giovanni Camarda
Tim Riffe
Simona Bignani
Enrique Acosta

TAG Working Group I

October 1st, 2021

Data and aim

- Death and exposures by
  - five years age-group: 0-4, 5-9, ..., 85+
  - females and males separately

Data and aim

- Death and exposures by
  - five years age-group: 0-4, 5-9, ..., 85+
  - females and males separately
- 2019 (baseline):
  - **Source:** Global Health Estimates (GHE)
  - **Availability:** all 194 populations

Data and aim

- Death and exposures by
  - five years age-group: 0-4, 5-9, ..., 85+
  - females and males separately
- 2019 (baseline):
  - **Source:** Global Health Estimates (GHE)
  - **Availability:** all 194 populations
- 2020:
  - **Source:** Various
  - **Availability:** only 60 populations

Data and aim

- Death and exposures by
  - five years age-group: 0-4, 5-9, ..., 85+
  - females and males separately
- 2019 (baseline):
  - **Source:** Global Health Estimates (GHE)
  - **Availability:** all 194 populations
- 2020:
  - **Source:** Various
  - **Availability:** only 60 populations
- Information provided by William et al.
  - Overall excess deaths in 2020 for all populations
  - 8 clusters for all populations, based on external information

Data and aim

- Death and exposures by
  - five years age-group: 0-4, 5-9, . . . , 85+
  - females and males separately
- 2019 (baseline):
  - **Source:** Global Health Estimates (GHE)
  - **Availability:** all 194 populations
- 2020:
  - **Source:** Various
  - **Availability:** only 60 populations
- Information provided by William et al.
  - Overall excess deaths in 2020 for all populations
  - 8 clusters for all populations, based on external information

---
AIM

Estimate 2020 mortality by age and sex for pop. with no data

The two approaches

- William's approach:
  1. empirical ratio between mortality in 2019 and 2020 for population with both information
  2. group of these ratios based on mentioned clusters
  3. creation of a smooth cluster-specific distribution of ratios
  4. extract random ratio and apply it to 2019 mortality for population with no information in 2020

The two approaches

- William's approach:
  1. empirical ratio between mortality in 2019 and 2020 for population with both information
  2. group of these ratios based on mentioned clusters
  3. creation of a smooth cluster-specific distribution of ratios
  4. extract random ratio and apply it to 2019 mortality for population with no information in 2020
- Spin-off (our) approach:
  1. for a given population with both information within a cluster k:

$$\eta^{2020}(x) = \eta^{2019}(x) + c + \delta^k(x)$$

  with $\eta(x)$ and $\delta^k(x)$ assumed to be smooth and $\sum \delta^k(x) = 0$
  2. apply cluster-specific age-factor $\delta^k(x)$ to population with no information in 2020
  3. (uncertainty still to be included)

The two approaches

- William's approach:
  1. empirical ratio between mortality in 2019 and 2020 for population with both information
  2. group of these ratios based on mentioned clusters
  3. creation of a smooth cluster-specific distribution of ratios
  4. extract random ratio and apply it to 2019 mortality for population with no information in 2020
- Spin-off (our) approach:
  1. for a given population with both information within a cluster k:

  $$\eta^{2020}(x) = \eta^{2019}(x) + c + \delta^k(x)$$

  with $\eta(x)$ and $\delta^k(x)$ assumed to be smooth and $\sum \delta^k(x) = 0$
  2. apply cluster-specific age-factor $\delta^k(x)$ to population with no information in 2020
  3. (uncertainty still to be included)
- Final common step: redistribution of estimated 2020 deaths to match "known" overall excess mortality deaths

Clusters

Legend: 1 2 3 4 5 6 7 8 NA
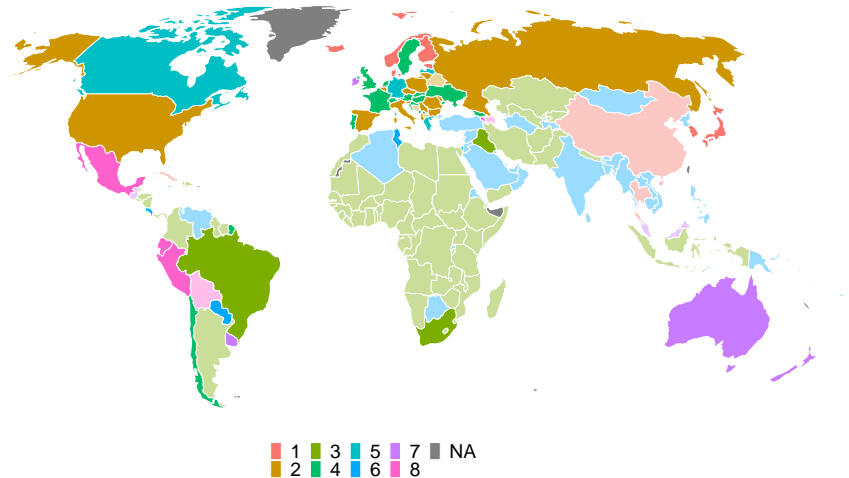
Clusters

Cluster	pop w/ data	# pop w/ data	# pop w/o data	% of pop. w/ data
1	CYP,DNK,EST,FIN,ISL, JPN,KOR,LUX,NOR	9	4	69%
2	ALB,AND,BEL,BGR,CZE, ESP,ITA,LTU,MDA,POL,ROU, RUS,SRB,SVN,USA	15	4	79%
3	BRA,IRQ,ZAF,COL	4	65	6%
4	AUT,CHE,CHL,FRA,GBR, GEO,HRV,HUN,MNE,NLD, PRT,SVK,SWE,UKR	14	0	100%
5	CAN,DEU,GRC,LVA,MLT	5	1	83%
6	CRI,ISR,PRY,TUN	4	51	7%
7	AUS,IRL,MUS,NZL,URY	5	7	42%
8	ARM,ECU,MEX,PER	4	2	67%
Totals		60	134	31%

Cluster-specific $\delta(x)$
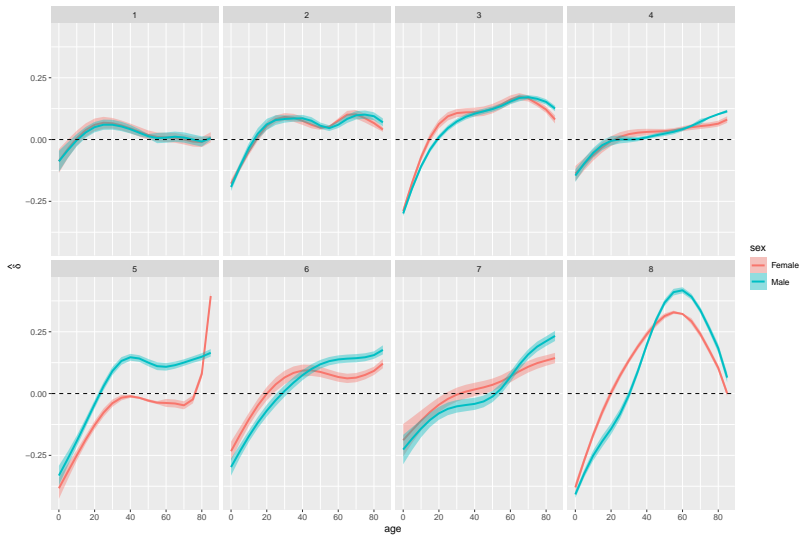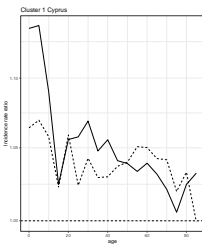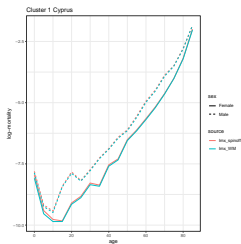
Log-mortality in 2019: in-sample fit

log−mortality, 2019
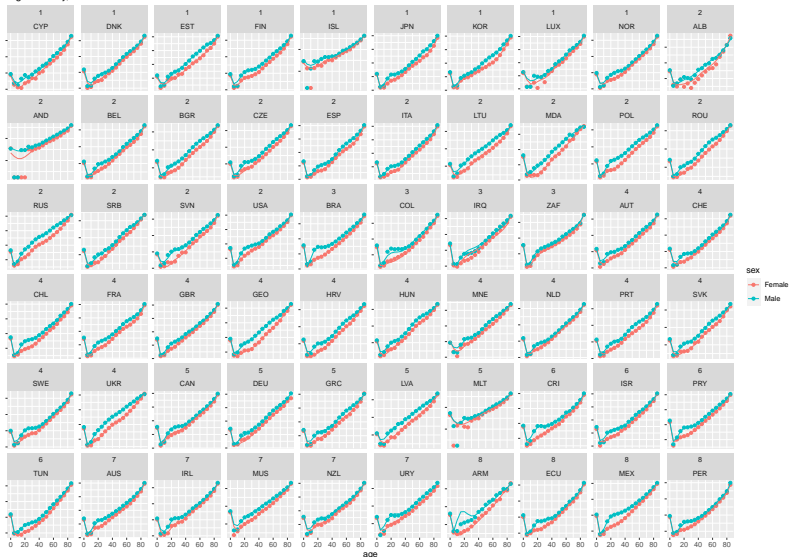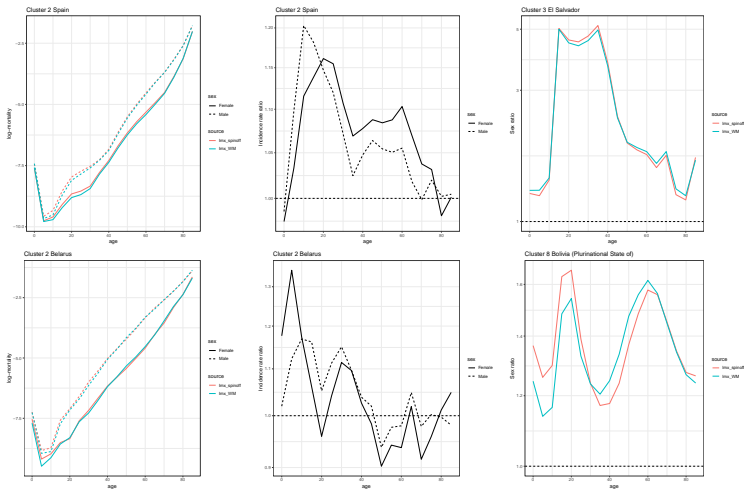
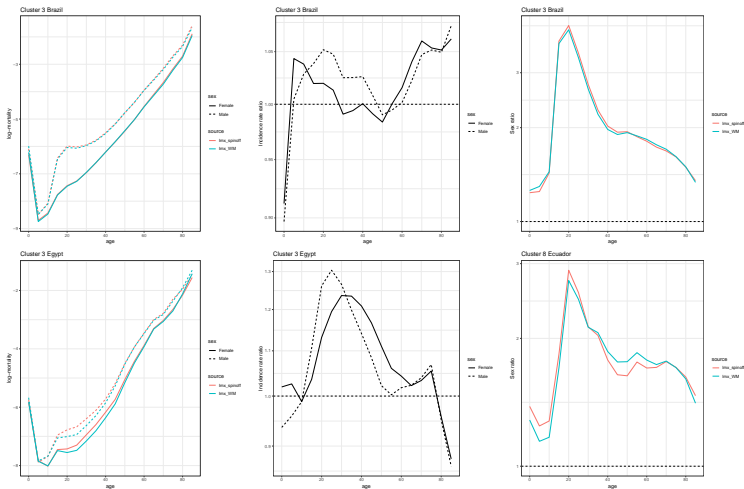# Log-mortality in 2020: in-sample fit

log–mortality, 2020
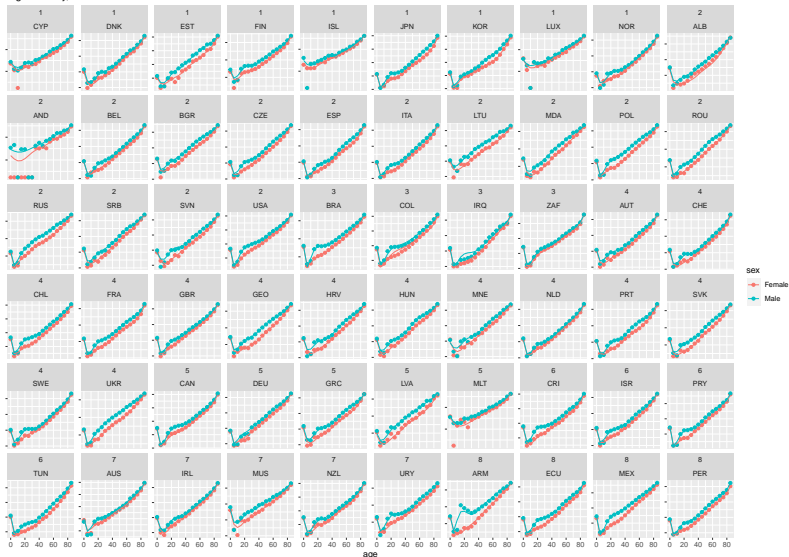
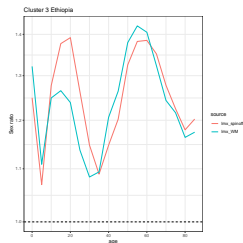# Out-of-sample comparison, Cluster 1 (69%)
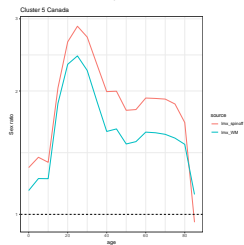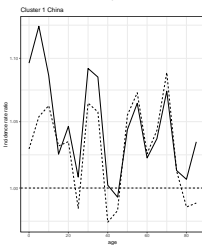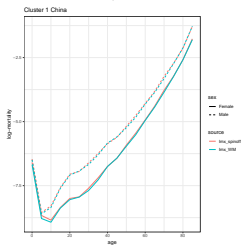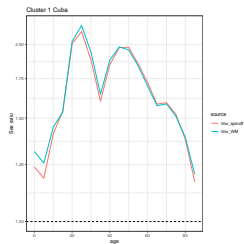
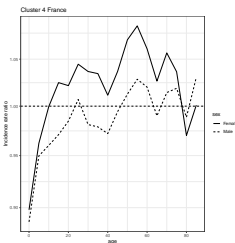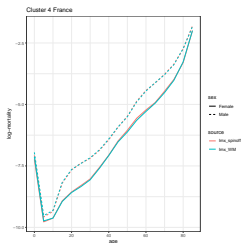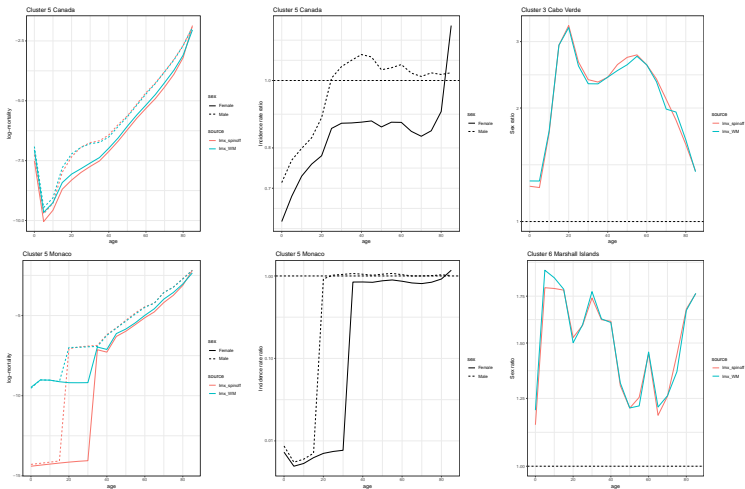# Out-of-sample comparison, Cluster 2 (79%)

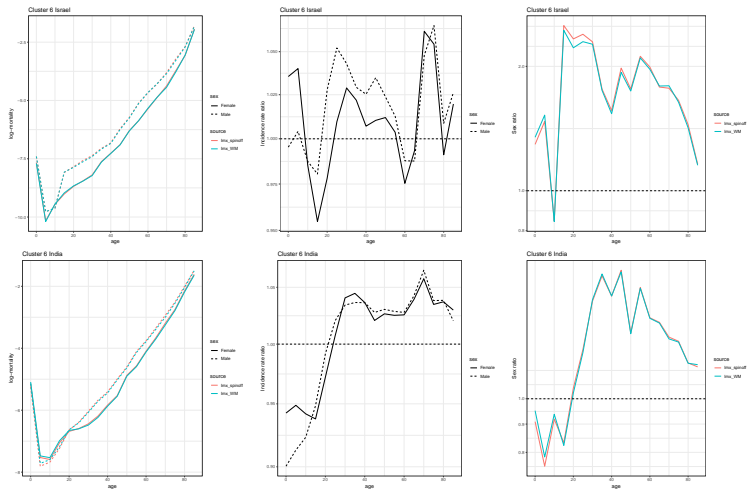# Out-of-sample comparison, Cluster 3 (6%)

Out-of-sample comparison, Cluster 4 (100%)

Out-of-sample comparison, Cluster 5 (83%)
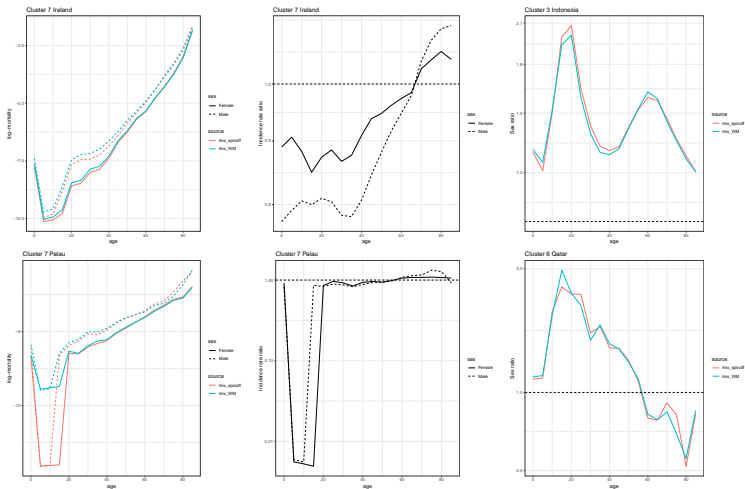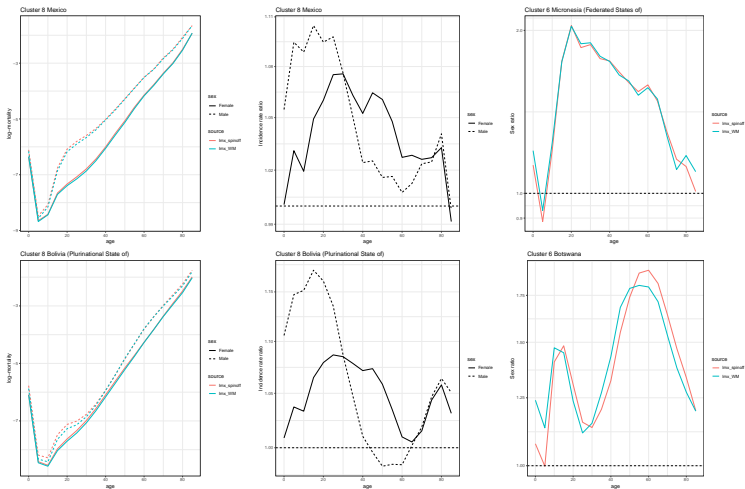
Out-of-sample comparison, Cluster 6 (7%)

Out-of-sample comparison, Cluster 7 (42%)

Out-of-sample comparison, Cluster 8 (67%)

Concluding remarks

- **Adequate coherence between WM and spin-off group outcomes**

Concluding remarks

- **Adequate coherence between WM and spin-off group outcomes**

- More data are now available in 2020 (model can be easily accommodated)

Concluding remarks

- **Adequate coherence between WM and spin-off group outcomes**

- More data are now available in 2020 (model can be easily accommodated)
- Diverse data sources contains diverse age-grouping structure

Concluding remarks

- **Adequate coherence between WM and spin-off group outcomes**

- More data are now available in 2020 (model can be easily accommodated)
- Diverse data sources contains diverse age-grouping structure
- Include uncertainty measures, coming from $\delta^k(x)$ & $\eta(x)$

Concluding remarks

- **Adequate coherence between WM and spin-off group outcomes**

- More data are now available in 2020 (model can be easily accommodated)
- Diverse data sources contains diverse age-grouping structure
- Include uncertainty measures, coming from $\delta^k(x)$ & $\eta(x)$
- Should we aim outcomes by single year of age?

Concluding remarks

- **Adequate coherence between WM and spin-off group outcomes**

- More data are now available in 2020 (model can be easily accommodated)
- Diverse data sources contains diverse age-grouping structure
- Include uncertainty measures, coming from $\delta^k(x)$ & $\eta(x)$
- Should we aim outcomes by single year of age?
- How sensible the model is with respect to the clusters and/or overall excess deaths?

Concluding remarks

- **Adequate coherence between WM and spin-off group outcomes**

- More data are now available in 2020 (model can be easily accommodated)
- Diverse data sources contains diverse age-grouping structure
- Include uncertainty measures, coming from $\delta^k(x)$ & $\eta(x)$
- Should we aim outcomes by single year of age?
- How sensible the model is with respect to the clusters and/or overall excess deaths?

- *Something else from your side?*