#### Modelling 2020 overall mortality

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TAG Working Group I

July 9th, 2021



#### Model

- For each population over age x, we have two mortality patterns:
  - $\eta^{1}(x)$  for the overall pre-pandemic years (sum up data < 2020)
  - $\eta^2(x)$  for 2020
- We model data in 2020 as follows:

$$\eta^2(x) = \eta^1(x) + c + \delta(x)$$

- c scaling factor
- $\delta(x)$  age-dependent adjustment component  $(\sum \delta(x) = 0)$
- Both  $\eta^1(x)$  and  $\delta(x)$  are assumed to be smooth
- The model is multiplicative at the force of mortality level:

$$e^{\eta^2(x)} = \mu^2(x) = e^{\eta^1(x)} e^c e^{\delta(x)} = \mu^1(x) e^c e^{\delta(x)}$$

• both  $e^c$  and  $e^{\delta(x)}$  can be interpreted as relative risk factors



#### Data

Sources for overall deaths:

Source	# of populations	2020	
		Total # deaths	Mean $\#$ of age-groups
WHO	13	6.6	19
STMF	27	4.6	18
Statistical bureaus	7	4.0	78
Eurostat	9	1.3	19
UN PD	11	0.5	20
Totals	67	6.6	25

• Criteria for selecting sources/year:

• 2020 must be available

• 2015-2019 when coming from the same source

• prioritize source coherence with respect to longer periods

• preference for more detailed age-groups

• Sources for the exposures: UN WPP (single year of age)

Age-range: 0-100Sexes combined

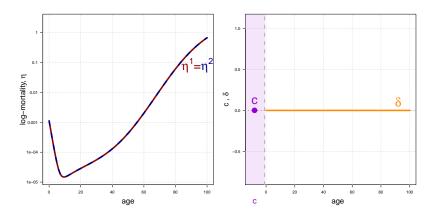
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#### A schematic illustration



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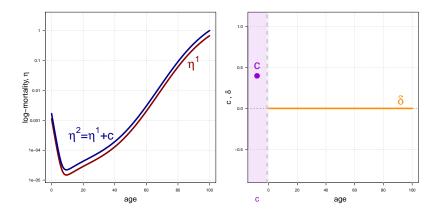
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#### A schematic illustration



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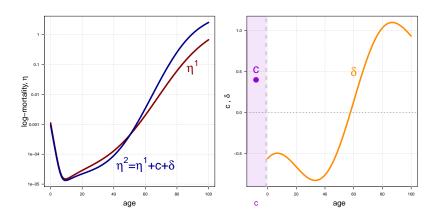
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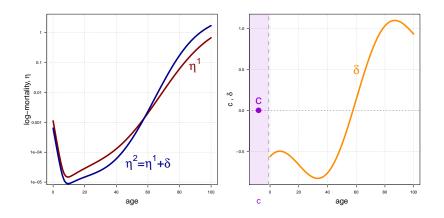
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#### A schematic illustration



#### A schematic illustration



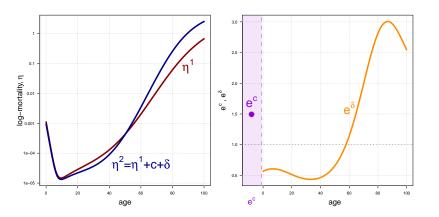
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# A schematic illustration: a relative risk perspective



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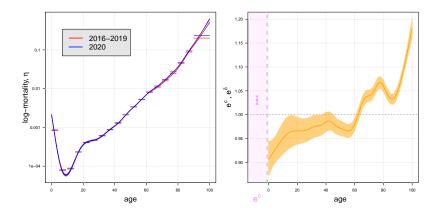
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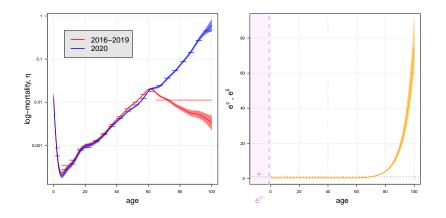
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# Actual data illustration 1: France (mainly old ages)

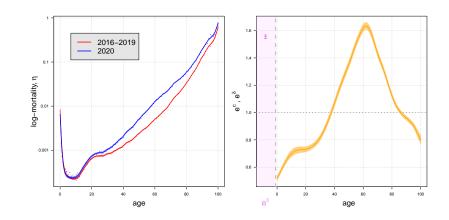


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Actual data illustration 3: Mongolia (clear data issues)



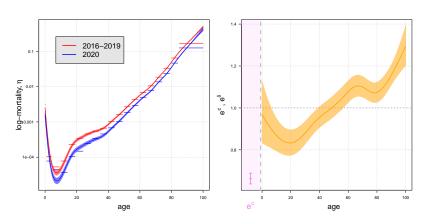
# Actual data illustration 2: Peru (middle-age hump)



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## Actual data illustration 4: Ireland (a good 2020?)

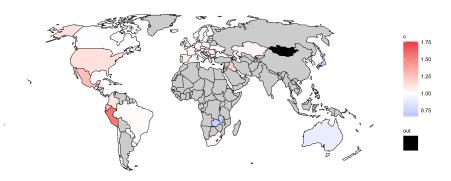


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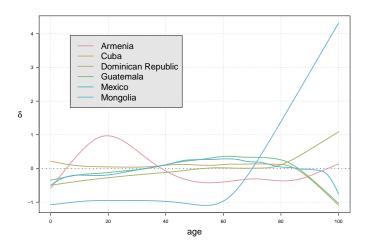
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# World Map with $e^c$ (relative risk scaling factor)



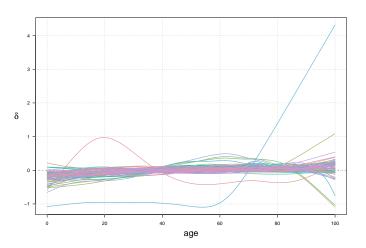
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## Age-dependent component $\delta(x)$



Parameter  $\delta$  for populations with clear data issue or peculiar patterns

# Age-dependent component $\delta(x)$

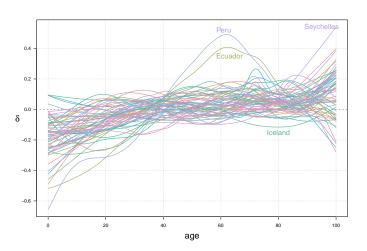


Parameter  $\delta$  for all available data

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# Age-dependent component $\delta(x)$

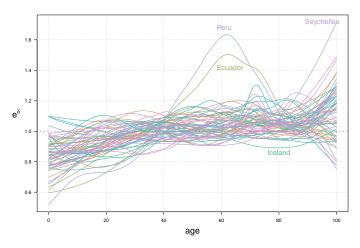


Parameter  $\delta$  for populations without clear data issue or peculiar patterns

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# Age-dependent component $e^{\delta(x)}$

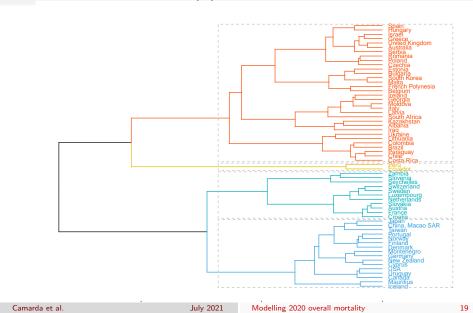


Parameter  $e^{\delta}$  for populations without clear data issue or peculiar patterns

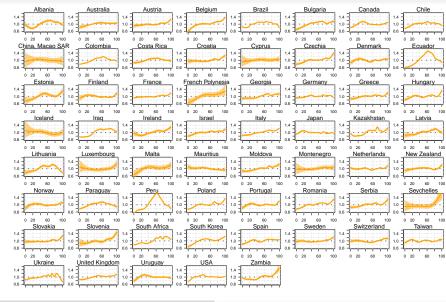
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## An attempt to cluster $\delta(x)$



# Age-dependent component $e^{\delta(x)}$



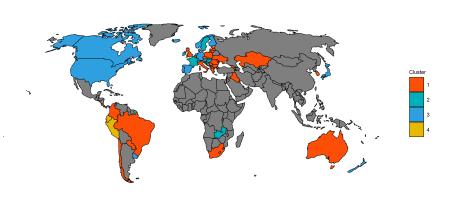
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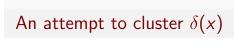
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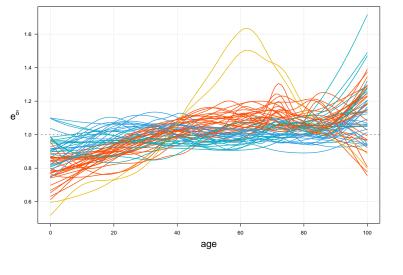
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# An attempt to cluster $\delta(x)$



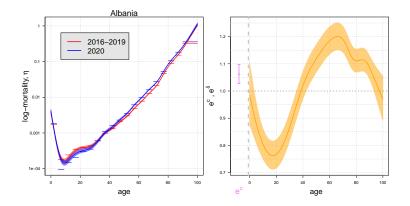
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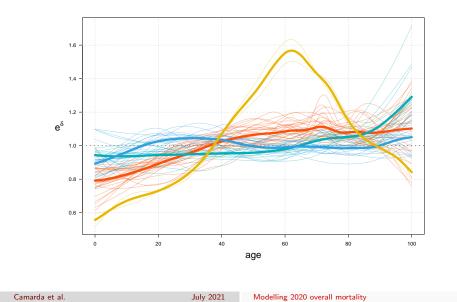


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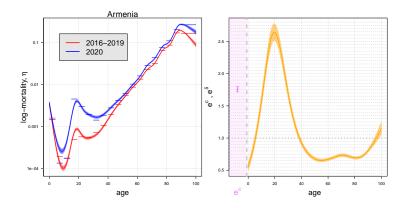


# An attempt to cluster $\delta(x)$



Modelling 2020 overall mortality

All populations



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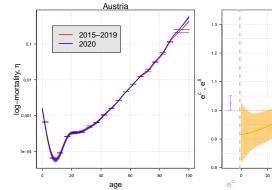
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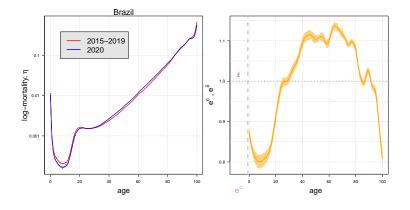
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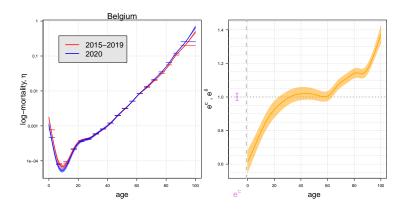
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## All populations





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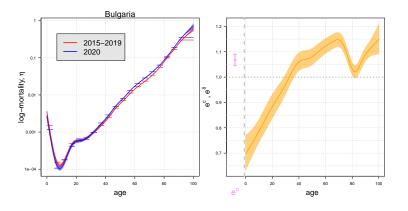
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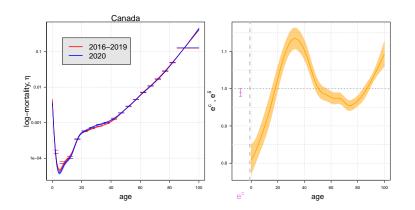
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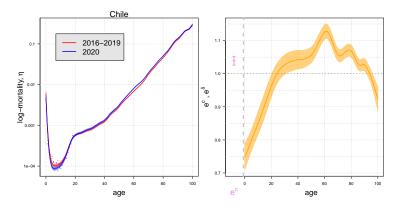
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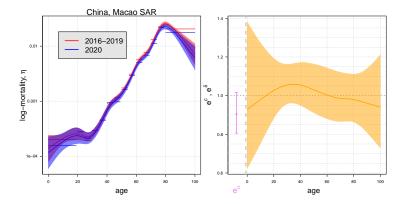
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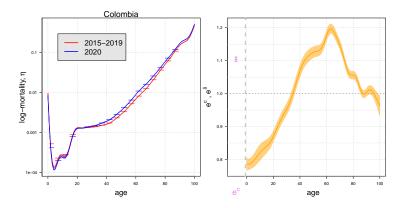
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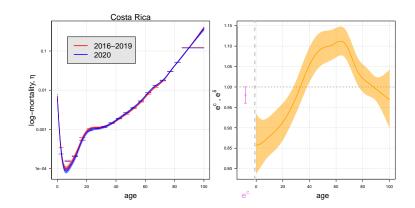


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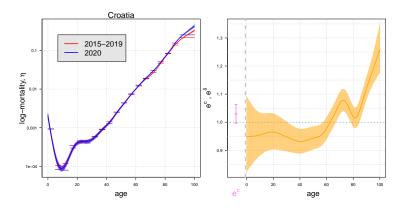
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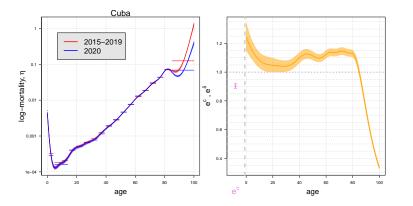
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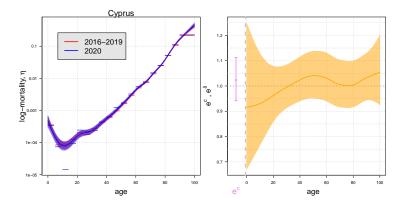


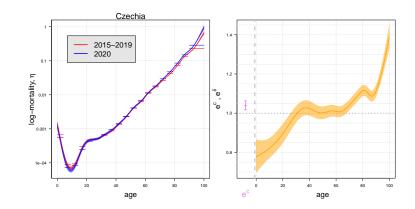
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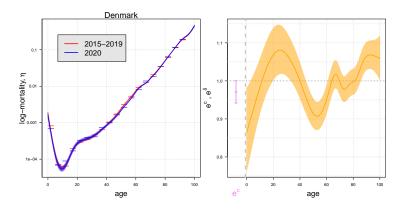
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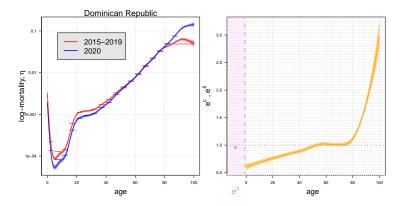
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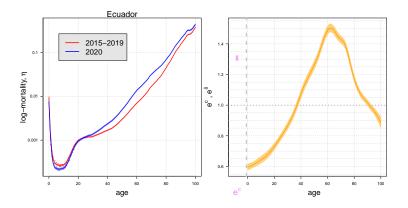


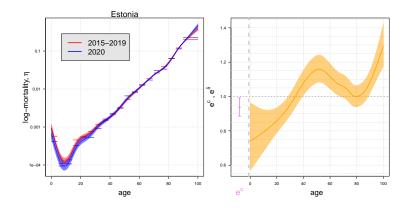


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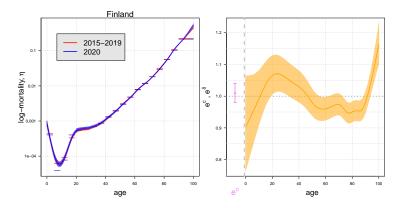


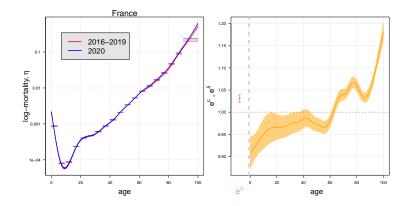
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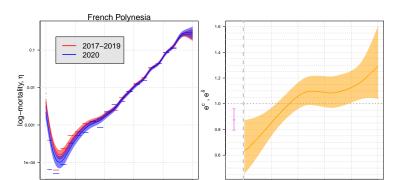


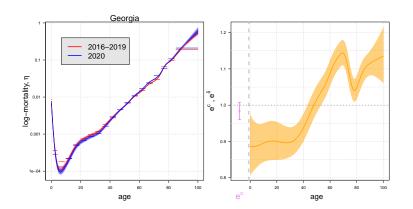
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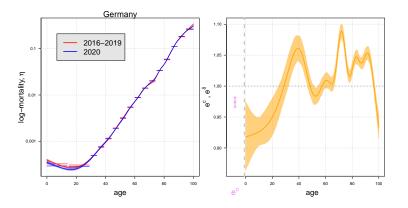
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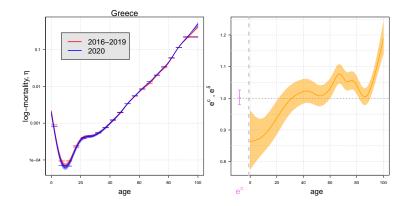
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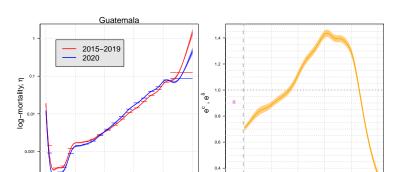
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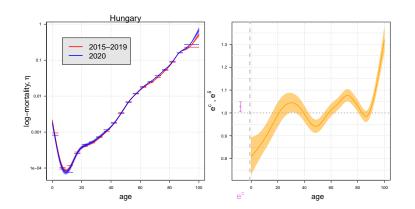


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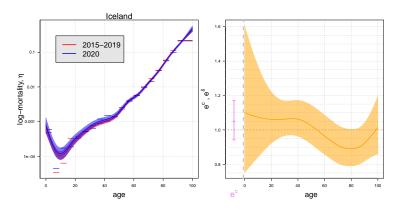
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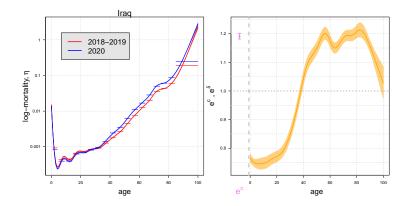
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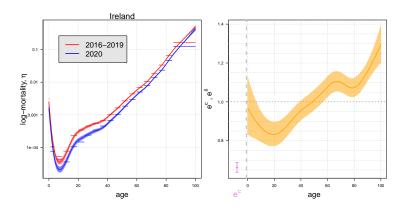


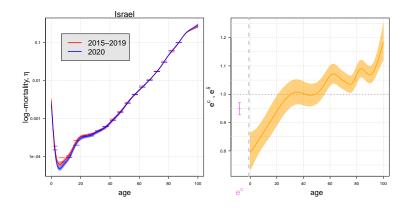


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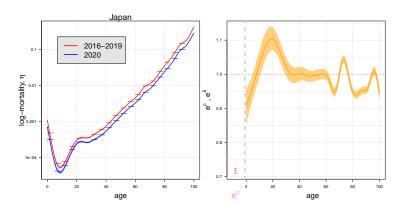
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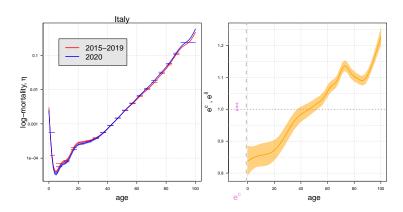
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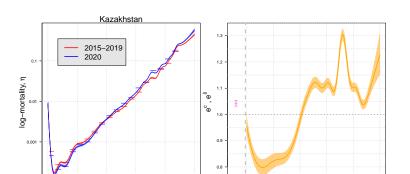
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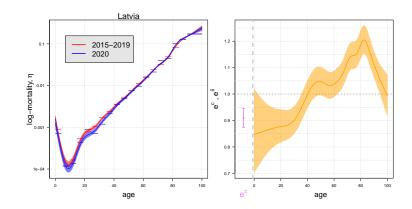
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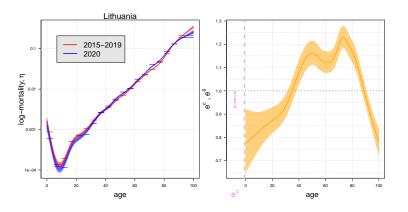
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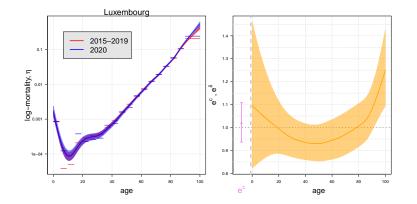
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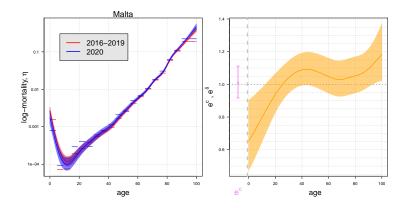


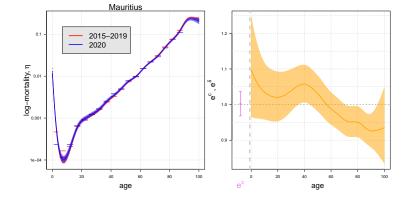
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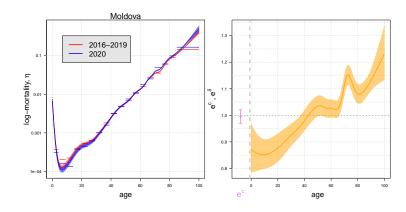
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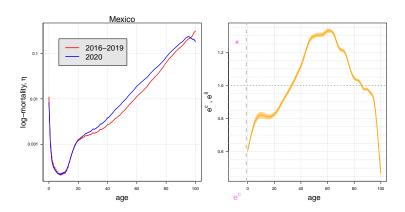
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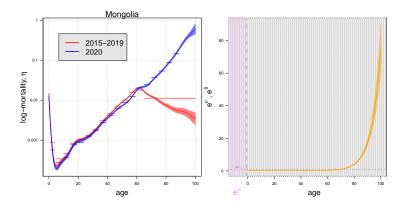
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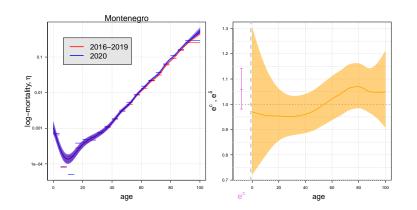


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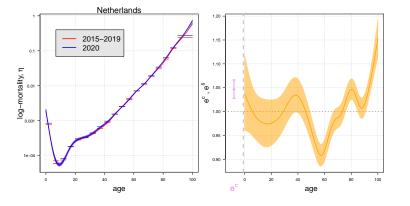
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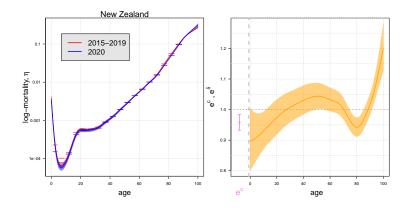
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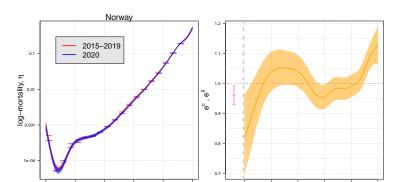




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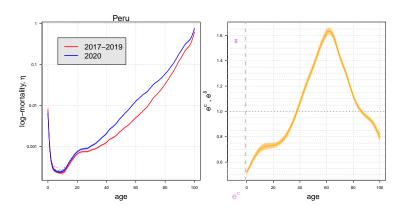
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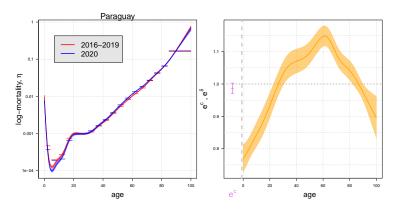
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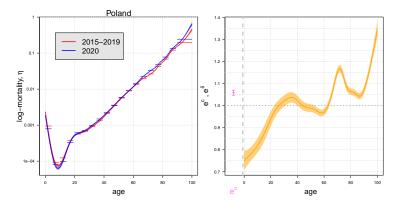
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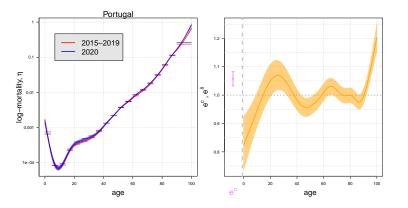


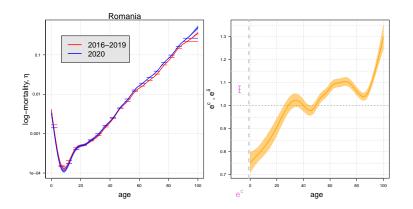
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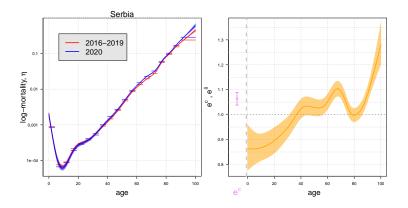
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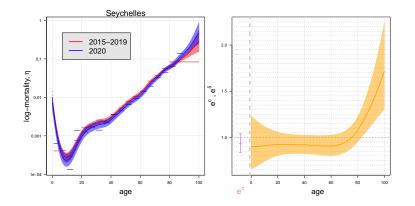
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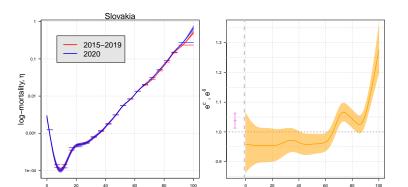


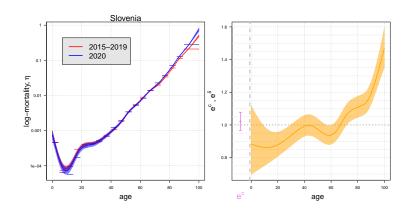


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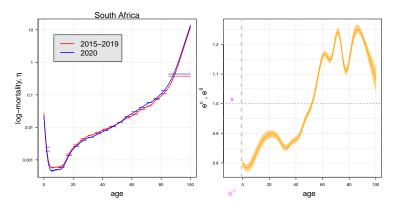
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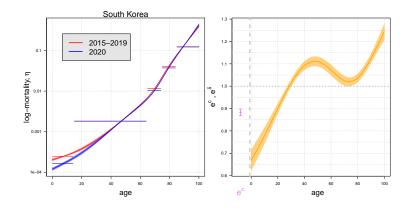
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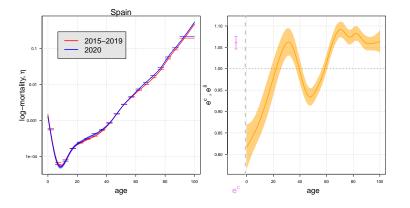


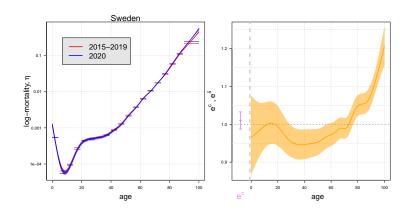
Camarda et al. July 2021 Modelling 2020 overall mortality 79 Camarda et al. July 2021 Modelling 2020 overall mortality 8





# All populations





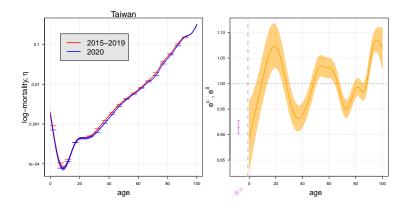
Camarda et al. July 2021 Modelling 2020 overall mortality 81

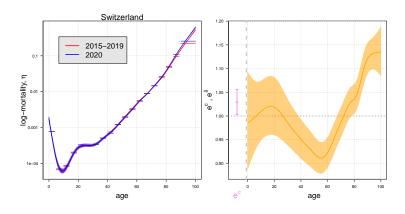
Camarda et al. July 2021 Modelling 2020 overall mortality 83

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## All populations

# All populations





Camarda et al. July 2021 Modelling 2020 overall mortality

Camarda et al.

July 2021 Modelling 2020 overall mortality

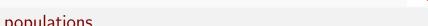
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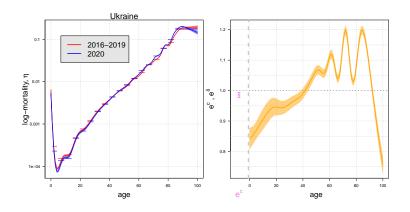
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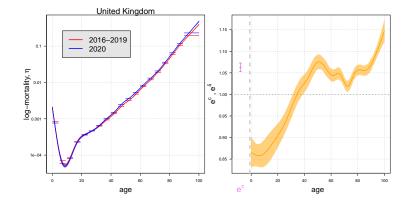


All populations

# All populations





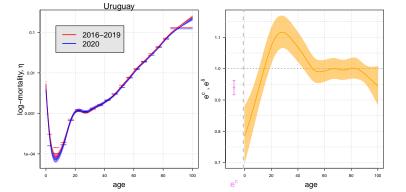


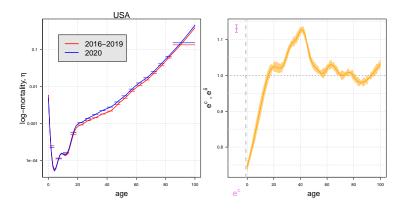
Camarda et al July 2021 Modelling 2020 overall mortality Camarda et al. Modelling 2020 overall mortality

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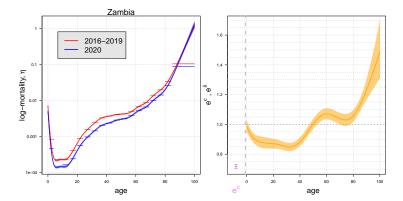
## All populations





Camarda et al July 2021 Modelling 2020 overall mortality Camarda et al. July 2021 Modelling 2020 overall mortality





Camarda et al. July 2021 Modelling 2020 overall mortality