

Assessing the potential impact of COVID-19 on life expectancy

Guillaume Marois^{1,2}, Raya Muttarak^{2,3}, Sergei Scherbov²

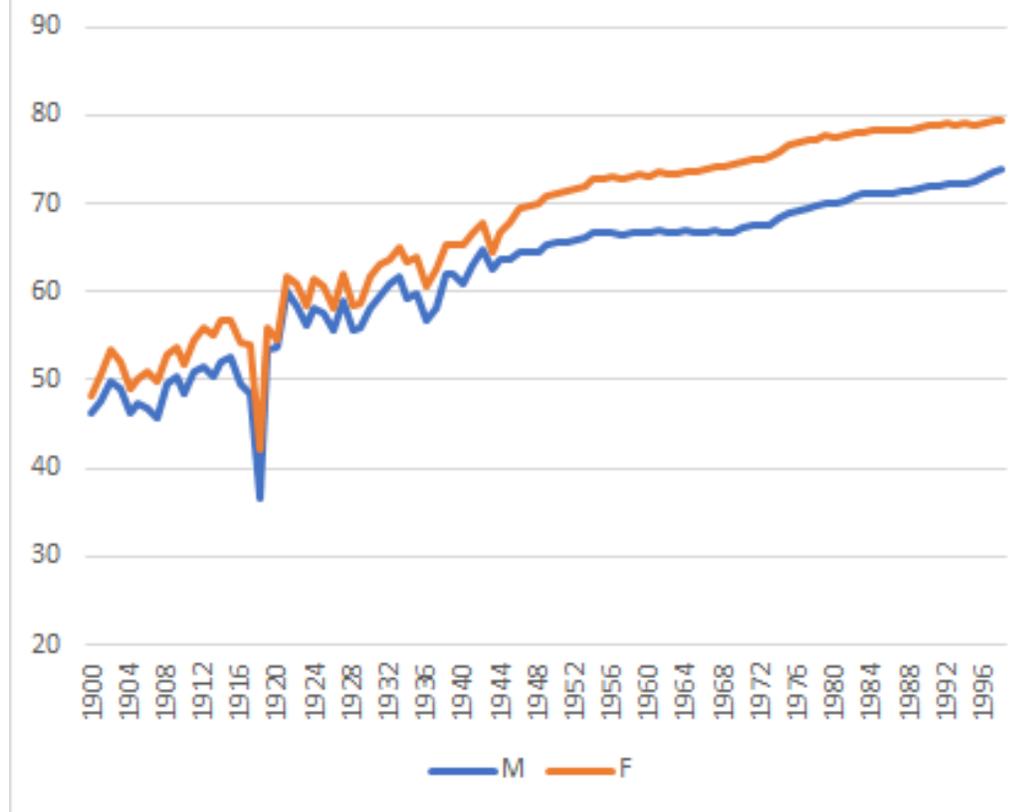
1. Asian Demographic Research Institute, Shanghai University
2. Wittgenstein Centre for Demography and Global Human Capital, International Institute for Applied Systems Analysis (IIASA)
3. School of International Development, University of East Anglia

Demographic aspects of the COVID-19 pandemic and its consequences

Wittgenstein Centre Conference 2020

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Life expectancy in the USA, 1900-98



Objectives

- To provide first estimates of the potential impact of the COVID-19 pandemic on period life expectancy
 - Range of scenarios of bias-adjusted age-specific case fatality rates
 - Range of scenarios of prevalence rates
 - Applied to different life tables:
 - 1) Very high life expectancy (North America and Europe, 79.2 years);
 - 2) High life expectancy (Latin America and the Caribbean, 76.2 years);
 - 3) Medium life expectancy (South Eastern Asia, 73.3 years);
 - 4) Low life expectancy (Sub-Saharan Africa, 62.1 years).
- A scenario approach (what if...): not a prediction of what will happen to life expectancy nor an assessment of what has already happened

Method: microsimulation

- Discrete-time microsimulation model that simulates the life of individuals week by week for a period of one year (built in SAS)
 - Parameters:
 - age-specific probabilities of dying (q_x): taken from aggregated lifetables (5-year age groups) (UN-World Population Prospects 2019);
 - prevalence rate of COVID-19 infection (i_x);
 - No age differential
 - distributed over the year following a normal distribution centered on the middle of the year and with a standard deviation of 10 weeks
 - length of illness (z), which is set at 2 weeks
 - age-specific probabilities of dying from COVID-19 among the infected population (f_x);

What are fatality rates?

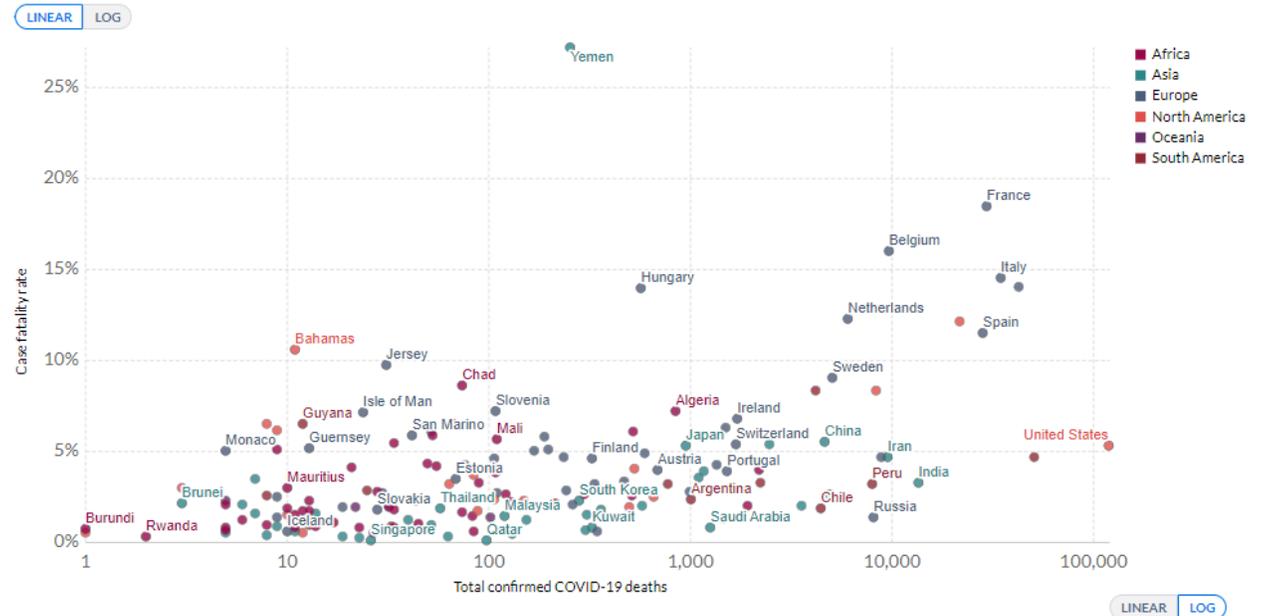
The official counts have many biases:

- Underreporting of milder cases → Upward bias in the fatality rate
- Time lags between diagnostic and death/recovery → downward bias in the fatality rate
- Methods vary among countries
 - France: 18%
 - Sweden: 10%
 - USA: 5%
 - Russia: 1%
 - Belarus: 0.5%

Case fatality rate vs. Total confirmed COVID-19 deaths, Jun 22, 2020

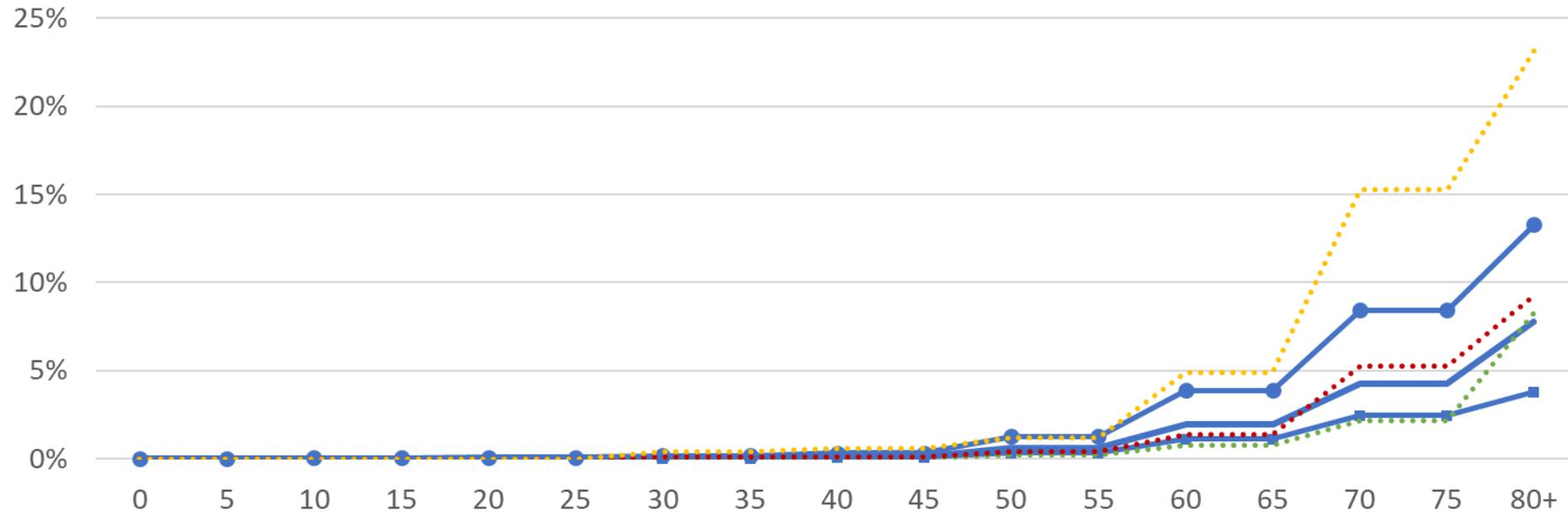
The Case Fatality Rate (CFR) is the ratio between confirmed deaths and confirmed cases. During an outbreak of a pandemic the CFR is a poor measure of the mortality risk of the disease. We explain this in detail at [OurWorldInData.org/Coronavirus](https://ourworldindata.org/coronavirus)

Our World
in Data



- Source of data for bias-adjusted age-specific case fatality rates
 - Verity R, Okell LC, Dorigatti I, Winskill P, Whittaker C, Imai N, et al. (2020)
Estimates of the severity of coronavirus disease 2019: a model-based analysis.
The Lancet Infectious Diseases
 - accounting for censoring and ascertainment biases
 - Hubei, China

Age-specific fatality rates of COVID-19

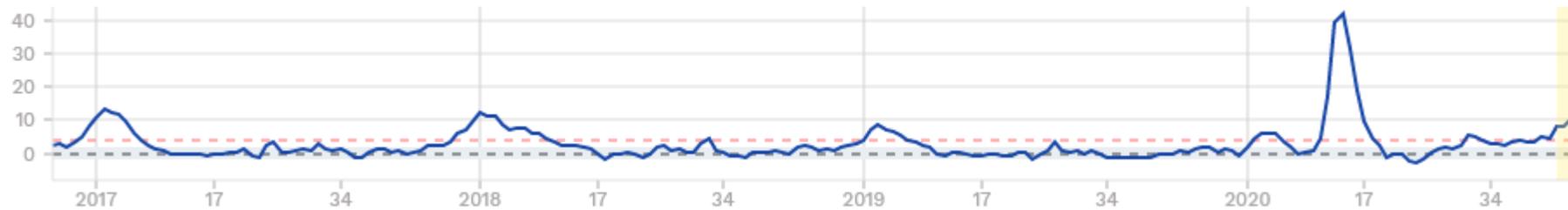


- Bias-adjusted estimates from Verity et al. - Central
- Bias-adjusted estimates from Verity et al. - Low (95%CrI)
- Bias-adjusted estimates from Verity et al. - High (95%CrI)
- Institut Pasteur (modeled)
- Korea - Reported data
- Italy - Reported data

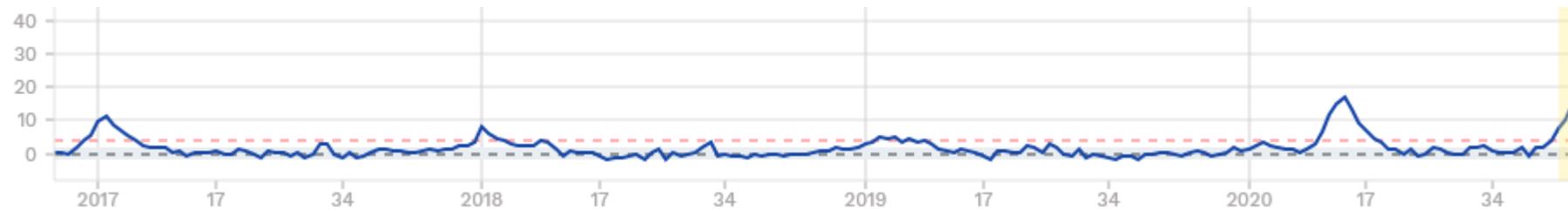
Would those who died from COVID-19 have died anyway during the year?

- No evidence

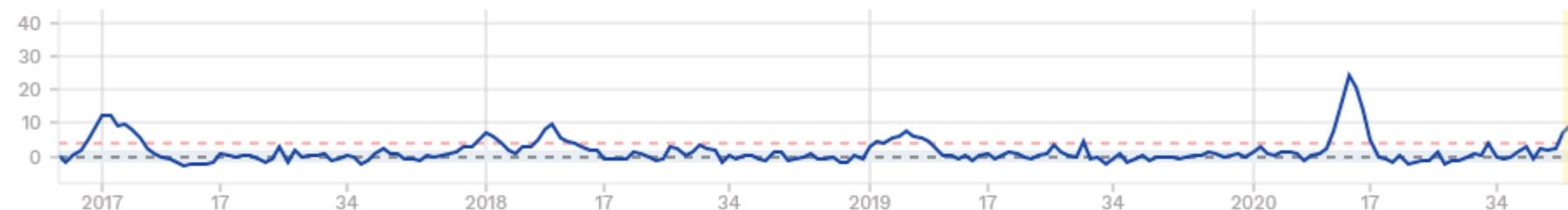
Spain



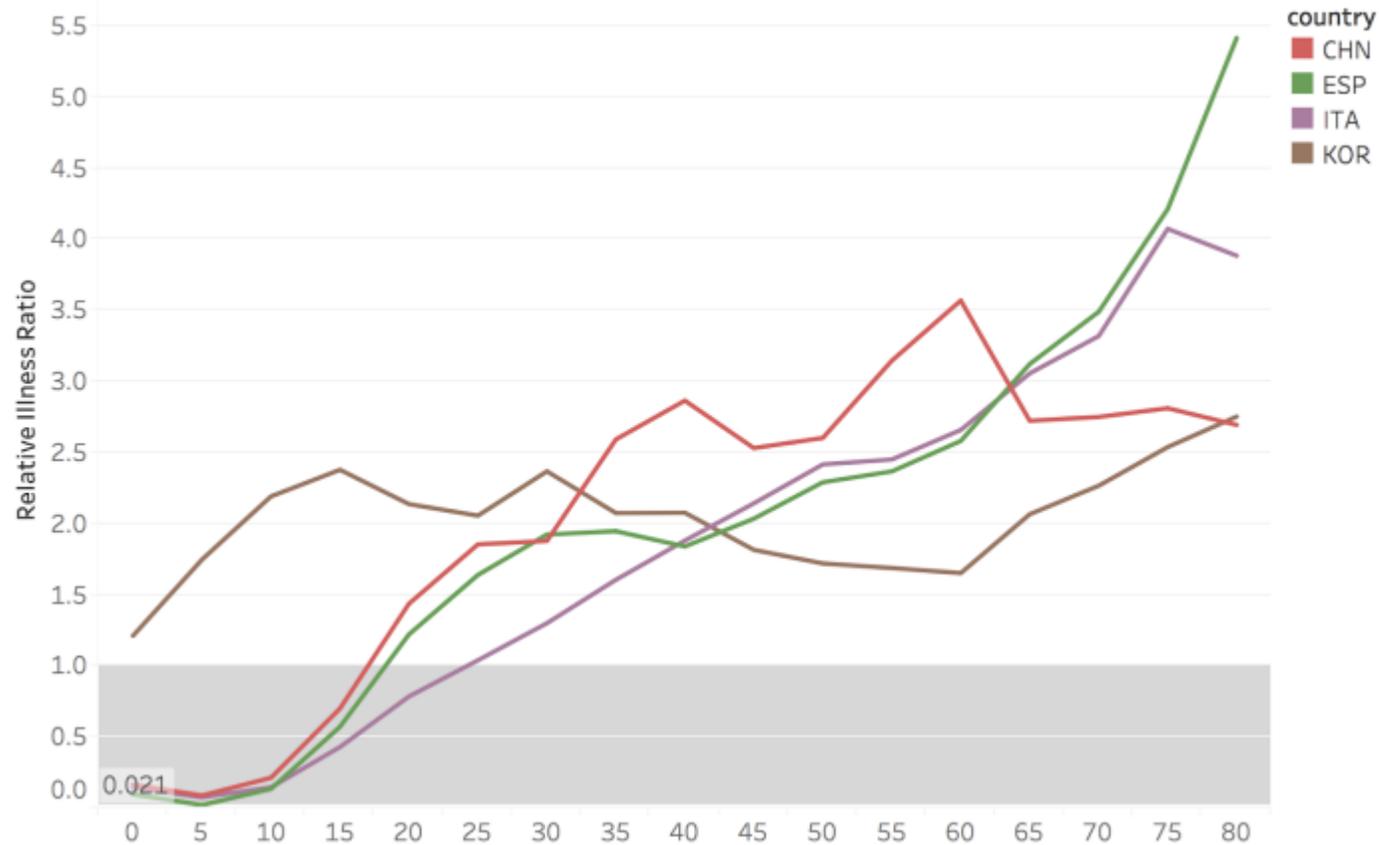
Italy



France



There is no clear pattern in age-specific prevalence rates



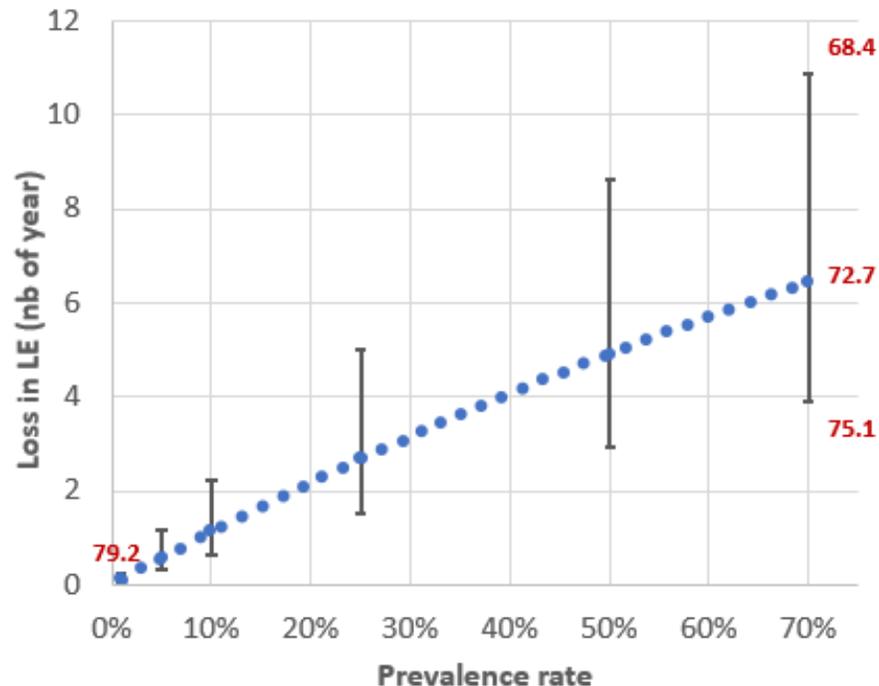
We tested 6 scenarios:

- 1% of the population infected over a year, no age differential;
- 5%;
- 10%;
- 25%;
- 50%;
- 70%

Figure 5 Relative Illness Ratio by 5-year age groups⁴.

- In high life expectancy regions (North America and Europe), each percentage increase in the prevalence of COVID-19 infection would reduce life expectancy by about 0.1 year.
- At 10% of prevalence, one year is lost. At 70%, almost 7 years are lost.

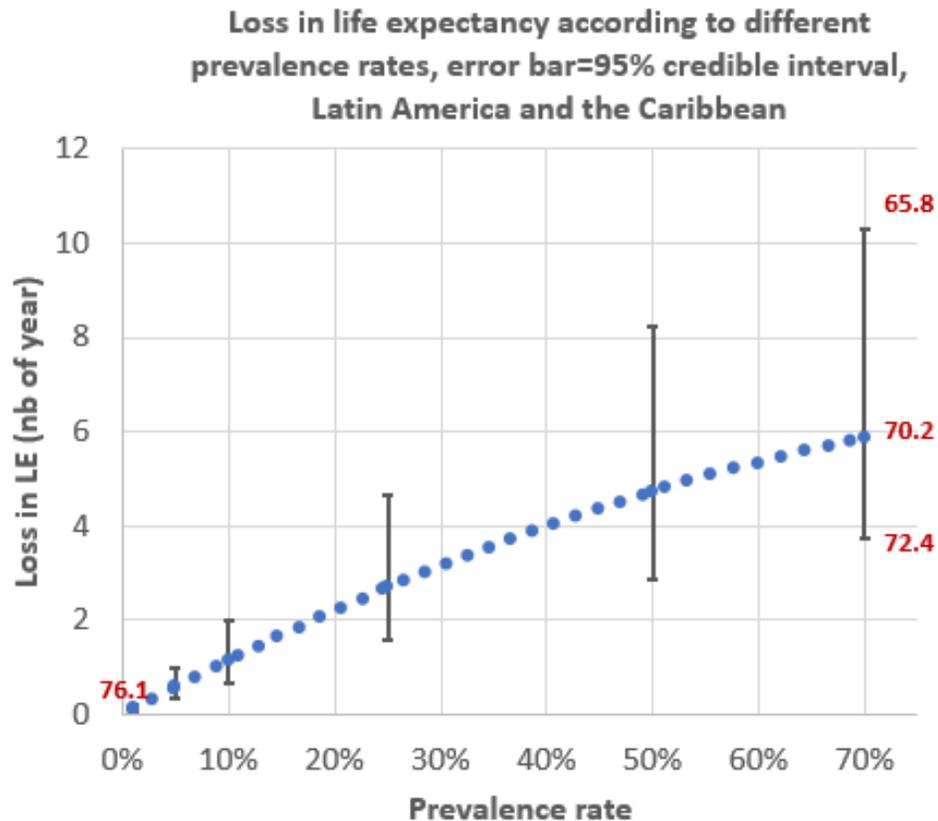
Loss in life expectancy according to different prevalence rates, error bar=95% credible interval, North America and Europe



Total fatality rate, North America and Europe

f_x = central estimate	1%
f_x = lower limit 95% CrI	0.6%
f_x = upper limit 95% CrI	2.0%

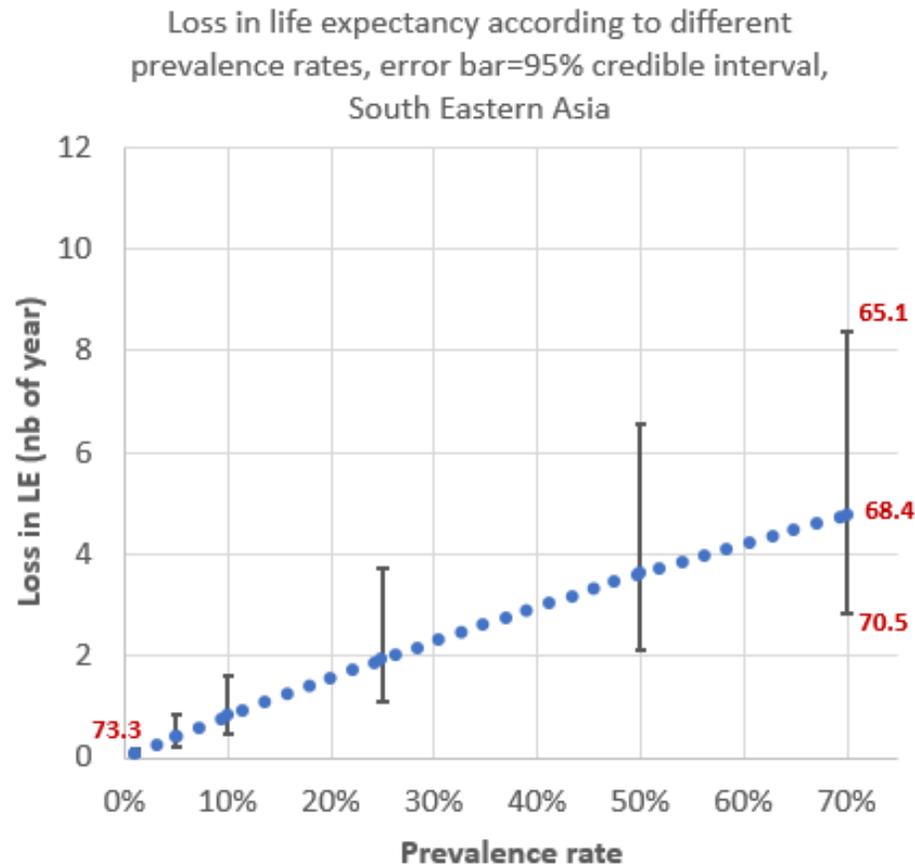
- At 70% of prevalence rate, the loss in life expectancy reaches also about 6 years in Latin America and the Caribbean.
- The total fatality rate would however be much smaller than in North American and Europe because of a younger age structure.



Total fatality rate, Latin America and the Caribbean

f_x = central estimate	0.5%
f_x = lower limit 95% CrI	0.3%
f_x = upper limit 95% CrI	1.1%

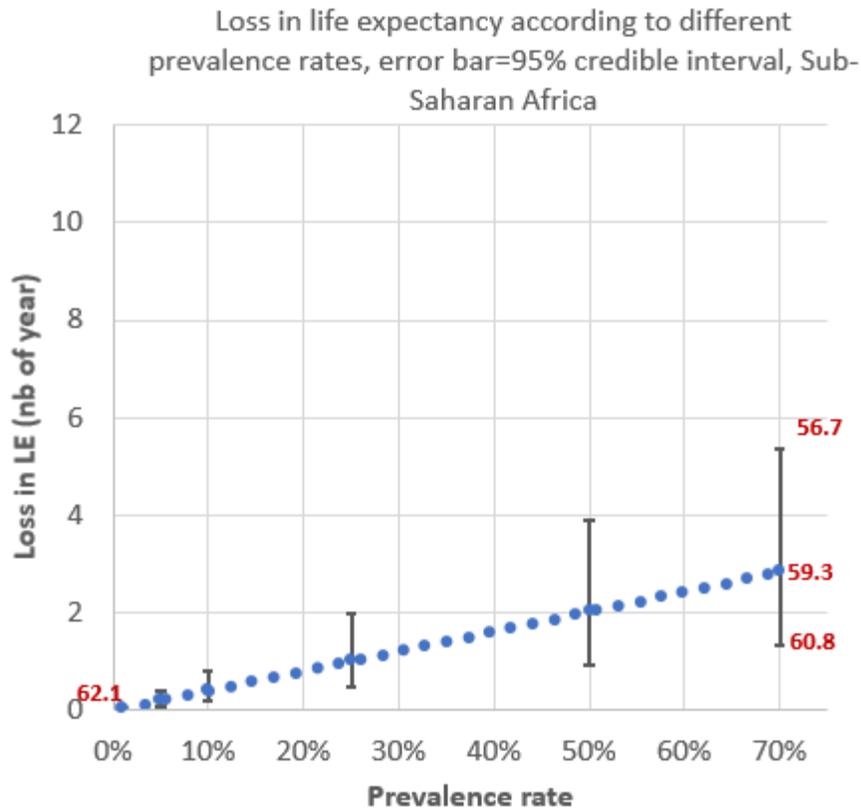
- The higher are mortality rates at older ages (q_x), the lower is the impact of COVID-19 on life expectancy.
- One year lost in life expectancy corresponds to a prevalence of infection of about 15% in South Eastern Asia.



Total fatality rate, South Eastern Asia

$f_x = \text{central estimate}$	0.5%
$f_x = \text{lower limit 95\% CrI}$	0.2%
$f_x = \text{upper limit 95\% CrI}$	0.9%

- In low life expectancy regions, the impact of COVID-19 would be smaller.
- One year lost in life expectancy would be lost with a prevalence rate of 25%. At 70%, 3 years are lost.
- In Sub-Saharan Africa, assuming the same age-specific fatality rates, the total fatality rate would be 5 times lower than in North America and Europe because of the age structure.



Total fatality rate, Sub-Saharan Africa

$f_x = \text{central estimate}$	0.2%
$f_x = \text{lower limit 95\% CrI}$	0.1%
$f_x = \text{upper limit 95\% CrI}$	0.4%

Comparison with other studies based on excess of mortality

- Not directly comparable
 - True prevalence is unknown in most cases (according to CDC, it can be as much as 10x higher than confirmed cases)
 - Excess mortality can be directly and indirectly related to COVID-19
- 1.5 years in the US, >2.5 in Peru and Ecuador, June (Heuveline and Tzen 2020)
- 4.1 years for men and 2.6 years for women in Bergamo, April (Ghislandi et al. 2020)
 - >50% had antibodies according to serological tests
- About 1 year in Spain, 2.8 years in Madrid, March (Trias-Llimos et al. 2020)
 - Weekly life expectancy: 6.1-7.6 years, up to 15 years in Madrid

Summary

- As long as the prevalence of COVID-19 infection remains low in a region, the pandemic would not affect life expectancy substantially
- At merely 2% of prevalence of COVID-19 infection, the secular increase in life expectancy (0.2) is likely to be suspended
- At 10% of prevalence, the loss in life expectancy is likely to be above 1 year in high life expectancy countries
- At 70%, it would translate into the years of life lost between 4 to 11 years in high life expectancy regions, between 3 to 9 years in medium life expectancy regions and between 1 to 5 in low life expectancy regions.
 - A clear break in the historical trend might be observed and would be visible when plotting the age pyramids in the coming few years
- The evidence from our modelling could be applied to specific areas as well as to countries as a whole at given level of prevalence

Some limitations

- The results should be interpreted in the context that all other things are kept constant, albeit being rather unrealistic
 - likely the true age-specific case-fatality rates differ among regions given country differentials in policy interventions, health infrastructure and population behaviors
- Mortality rates are not independent of the prevalence of COVID-19 infection
 - health infrastructures are likely to be overloaded and to not be able to provide care for everyone who needs it, resulting in higher mortality rates both from the virus itself and from other causes

Thank you
marois@iiasa.ac.at