

National Institute for Public Health and the Environment *Ministry of Health, Welfare and Sport* 

# Evaluating the COVID-19 responses of Belgium, Denmark, Germany, the Netherlands, Sweden and the United Kingdom, February-June 2020: A counterfactual modelling study

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### Background

- Differences in responses to the COVID-19 pandemic among Northwestern European countries have generated extensive discussion.
- What would the health impact have been, had a country adopted

# Results, continued



another country's response?

# Objective

Explore how mortality during the first COVID-19 wave (Feb-June 2020) may have differed, had Belgium, Denmark, Germany, the Netherlands, Sweden and the UK adopted the responses of the other countries.

## Methods

- A counterfactual modelling framework from Mishra et al. [1] was used.
- The time-varying reproduction number  $R_t$  the number of new persons infected by a single infectious person who is infected at time t for each country was estimated using time series of laboratory-confirmed COVID-19 deaths by date of death.
- An epidemic for each country was simulated until March 13, 2020, maintaining the country's value for  $R_t$  without control measures.
- Counterfactual assessment was conducted by interchanging the reduction in R<sub>t</sub> (i.e., R<sub>t</sub> with control measures relative to the R<sub>t</sub> without control measures) between countries from March 13 to July 1, 2020.

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Figure 2: Estimated median daily COVID-19 deaths per million population in the Netherlands, showing observed data (blue bars) and counterfactual analyses (red lines with 95% CI) after transferring the reduction in reproduction number  $R_t$  from Belgium, Denmark, Germany, Sweden and the UK to the Netherlands from March 13 to July 1, 2020.

- Accumulated over the wave, Belgium's and Denmark's responses doubled COVID-19 deaths in the Netherlands, Germany's and the UK's tripled, and Sweden's led to a seven-fold increase (Figure 3, top-left).
- The order of expected deaths adopting the other countries' responses (Figure 3, bars), was consistent across countries (Figure 3, panels): the response of the Netherland resulted in fewest deaths, followed by Belgium and Denmark, then the UK and Germany, and finally Sweden.
- Germany showed the largest mortality difference, with a twelve-fold variation in COVID-19 deaths between the responses of the Netherlands and Sweden (Figure 3, bottom-center).

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	Netherlands	Belgium		Denmark
			$600 \cdot$	

### Results

- Highest reproduction number R<sub>t</sub> without control measures was found for the Netherlands and Belgium (3.7), followed by the UK (3.6), Germany (3.5), Sweden (3.3), and Denmark (3.2).
- Focusing on the Netherlands, the actual decline in R<sub>t</sub> (Figure 1, blue lines) was faster than the decline in other countries (Figure 1, red lines).
- Small variations in R<sub>t</sub> can have large impact on mortality. Adopting Sweden's response in the Netherlands would have increased peak daily deaths from 10 to nearly 55 per million, while adopting other countries' responses would raise the rate to 18-35 deaths per million (Figure 2).





Figure 3: Observed cumulative COVID-19 deaths per country up to July 1, 2020 (black lines) compared with those from counterfactual responses (black lines with 95% CI shown as red bars), after transferring the reduction in reproduction number  $R_t$  between countries from March 13 to July 1, 2020.

### Conclusions

In a fast-growing epidemic, small differences in the timing and

Figure 1: Estimated median reproduction number  $R_t$  for the Netherlands (blue lines), and the  $R_t$  for the different counterfactual analyses (red lines), after transferring the relative reduction in  $R_t$  from Belgium, Denmark, Germany, Sweden and the UK to the Netherlands from March 13 to July 1, 2020.

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National Institute for Public Health and the Environment P.O. Box 1 | 3720 BA Bilthoven The Netherlands www.rivm.nl/en effectiveness of measures can result in large variations in mortality Counterfactual responses from the six Northwestern European countries revealed a seven-fold to twelve-fold difference between lowest and highest mortality rate

### References

1) Mishra et al. Sci Rep. 2021, 11(1):16342.

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### Disclosures

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