Supplementary Material

Methods:

Regression equation used to estimate expected deaths (SEq1)

$$\text{Log}[E(Yt_i)] = \text{intercept} + \beta_1 * t_i + \beta_2 * \sin(2\pi * t_i/(365.25/7)) + \beta_3 * \cos(2\pi * t_i/(365.25/7)) + \beta_4 * \sin(2\pi * t_i/((365.25/2)/7)) + \beta_5 * \cos(2\pi * t_i/((365.25/2)/7))$$

Where, $E(Yt_i)$ is the expected age standardized death rate at week i. Time trends were accounted for with a time variable "t_i" that took values from 1 (1/2015) to n (52/2019), and seasonality was addressed using sine and cosine terms of 1 year ($2\pi * t_i /(365.25/7)$) and half year ($2\pi * t_i/((365.25/2)/7)$) periods.

Pallari CT, *et al. BMJ Glob Health* 2024; 9:e013018. doi: 10.1136/bmjgh-2023-013018

Table S1. Summary of national data sources, period of available mortality data, time unit, availability of sex and age-specific data, and data quality of civil registration and vital statistics systems per country.

Country	Partners	Access Date	Source	Public data (Y/N)	Link (if available)	Notes	Time Unit	Weekly sex specific data available	Weekly age specific data available	% Completeness of vital registration systems*
Australia	Deakin University	May 9th, 2022	Australian Bureau of Statistics	YES			ISO	YES	YES	100
Austria	Department for Epidemiology, Center for Public Health, Medical University of Vienna	August 22nd, 2022	Cause of death statistics, Statistics Austria	NO			ISO	YES	YES	100
Belgium	Statistics Belgium	NA	National register	YES	Belgium		ISO	YES	YES	99.8
Brazil	Federal University of Rio de Janeiro and Fluminense Federal University	July 13th, 2022	The Mortality Information System	YES	Brazil		Epi	YES	YES	99.3
Cyprus	University of Nicosia & Health Monitoring Unit, Cyprus Ministry of Health	June 2022	Eurostat	YES	Cyprus		ISO	YES	YES	90.7
Denmark	Statistics Denmark	August 2022	Central Persons Register	YES	Denmark		Epi	YES	YES	100
England and Wales	St George's, University of London	June 25th, 2022	Office for National Statistics	YES	England and Wales		National	YES	YES	100
Estonia	National Institute for Health Development	June 14th, 2022	Estonian Causes of Death Register	YES	Estonia		ISO	YES	YES	100
France	EHESP	June 3rd, 2022	Institut National de la Statistique et des Etudes Economiques (INSEE)	YES	France		ISO	YES	YES	100
Georgia	National Center for Disease control and Public	June 2021, June 2022	Vital Registration System	NO			ISO	YES	YES	94.3

	Health (Primary organization), National Statistics Office of Georgia (partner organization)									
Greece	Laboratory for Health Technology Assessment, University of West Attica	October 3rd, 2022	Hellenic Statistical Authority	YES	Greece		ISO	YES	YES	100
Israel	Central Bureau of Statistics	2021-2022	Code list from death certificates	NO			Epi	YES	YES	100
Italy	Department of Medicine, University of Perugia	2019-2021	National Health System	NO			Epi	YES	YES	100
Kazakhstan	Asfendiyarov Kazakh National Medical University	2021-2022	Ministry of health reports and the Republican Center of e-health records	NO			ISO	YES	YES	88.3
Mauritius	Statistics Mauritius	2022	Statistics Mauritius - Government agency	NO			National	YES	YES	99.8
Northern Ireland	St George's, University of London	June 25th, 2022	Northern Ireland Statistics and Research Agency	NO			National	NO[a]	YES	100
Norway	University of Oslo	Regularly	Statistics Norway, The Cause of Death Registry	YES	Norway		ISO	YES	YES	100
Peru	Universidad del Pacífico	2021-2022	Ministerio de Salud	YES			ISO	NO[b]	YES	64.4
Poland	Nicolaus Copernicus University in Toruń	October 10th-11th, 2022	Statistics Poland	YES	Poland		ISO	YES	YES	100
Slovenia	National Institute of Public Health	2022	Human Mortality Database	YES			ISO	YES	YES	94.8
Spain	University of Oviedo	July 31st, 2022	Spanish Institute of Statistics	YES	Spain		ISO	YES	YES	100
Sweden	Karolinska Institutet	2022	National Board of Health and Welfare	YES	Sweden		ISO	YES	YES	100
Ukraine	Bogomolets National medical University	April 2020, 2021	Bogomolets National medical University, http://database.ukrcensus.gov.ua/MULT/Dialog/statfile_c_fil	YES	Ukraine Ukraine		ISO	YES	YES	100

			es/az.html							
USA	Our World in Data	July 2022	Human Mortality Database (HMD) and the World Mortality Dataset (WMD)	YES	USA		Epi	YES	YES	99.9

Abbreviations: ISO: International Organization for Standardization; Epi: epidemiological

* Source: Supplementary Appendix 1 from Abbafati C, Abbas KM, Abbasi-Kangevari M, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet*. 2020;396(10258):1204-1222. doi:10.1016/S0140-6736(20)30925-9

Table S2. Description of aggregate age groups created for the age-standardization according to age-specific all-cause mortality data availability.

Country	Age groups_Category 1	Age groups_Category 2	Age groups_Category 3	Age groups_Category 4	Age groups_Category 5
	<15, 15-44, 45-65, 65+	<20, 20-49, 50-69, 70+	<45, 45-64, 65+	<20, 20-69, 70+	<15, 15-64, 65+
Australia	x				
Austria	x				
Belgium			x		
Brazil	x				
Cyprus	x				
Denmark	x				
England and Wales	x				
Estonia		x			
France		x			
Georgia	x				
Greece					x
Israel	x				
Italy	x				
Kazakhstan		x			
Mauritius		x			
N. Ireland	x				
Norway	x				
Peru	x				
Poland	x				
Slovenia	x				
Spain					x
Sweden		x			
Ukraine				x	
USA					x

Equation used for age-standardization for the aggregate age groups category 1 (<15, 15-44, 45-65, 65+); CDR = age specific crude death rate

asdr1_totalpop=((CDR0-14*0.2615)+(CDR15-44*0.4597)+(CDR45-64*0.1968)+(CDR65+*0.08235))

(same equation applies for male and female population)

Equation used for age-standardization for the aggregate age groups category 2 (<20, 20-49, 50-69, 70+); CDR = age specific crude death rate

asdr2_totalpop=((CDR0-19*0.3462)+(CDR20-49*0.4354)+(CDR50-69*0.166)+(CDR70+*0.5275))

(same equation applies for male and female population)

Equation used for age-standardization for the aggregate age groups category 3 (<45, 45-64, 65+); CDR = age specific crude death rate

asdr3_totalpop=((CDR0-44*0.7212)+(CDR45-64*0.1968)+(CDR65+*0.08235))

(same equation applies for male and female population)

Equation used for age-standardization for the aggregate age groups category 4 (<20, 20-69, 70+); CDR = age specific crude death rate

asdr4_totalpop=((CDR0-19*0.3462)+(CDR20-69*0.6014)+(CDR70+*0.05275))

(same equation applies for male and female population)

Equation used for age-standardization for the aggregate age groups category 5 (<15, 15-64, 65+); CDR = age specific crude death rate

asdr5_totalpop=((CDR0-14*0.2615)+(CDR15-64*0.6565)+(CDR65+*0.08235))

(same equation applies for male and female population)

Table S3. Publicly available sources for the database of country-level sociodemographic variables (reported yearly) and pandemic related variables (reported weekly).

For Northern Ireland, England and Wales, data is only available for "population" and "vaccination". Hence, for other variables, the UK data were used.

Category	Variable Label	Description	Time span	Range of Values	Data Source	Weblink
Sociodemographic Variables						
POPULATION	Population density	Annual country population density per square kilometer	2020-2021	3.34 – 411.22	Department of Economic and Social Affairs, Population Division, United Nation	population_density
POPULATION	Median age	Median age of population (years)	2020-2021	27.96 – 46.83	Department of Economic and Social Affairs, Population Division, United Nation	median_age
POPULATION	Percent of population more than 65 years old	Percentage of total population in the select age group, both sexes combined	2020-2021	7.84 – 23.68	Department of Economic and Social Affairs, Population Division, United Nation	aged_65_older
POPULATION	Life expectancy	Life expectancy at birth, total (years)	2020	71.19 – 83.21	Demographic and Health Surveys, Multiple Indicator Cluster Surveys, Household surveys, UN Population Division	life_expectancy
POPULATION	Hypertension	Prevalence of hypertension (% of adults ages 30-79)	2019	20.70 – 49.20	Health Nutrition and Population Statistics	hypertension
POPULATION	Diabetes	Prevalence of Diabetes (% of population ages 20 to 79)	2019	3.60 – 10.70	Health Nutrition and Population Statistics	diabetes
POPULATION	Obesity	Prevalence of obesity among adults, BMI ≥ 30	2016	19.70 – 36.20	The Global Health Observatory, WHO	obesity
POPULATION	PM2.5 (air pollution)	PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)	2019	6.18 – 24.79	World Development Indicators	PM2.5

GOVERNMENT & ECONOMY	Gross Domestic Products (GDP)	GDP per capita, PPP (constant 2017 international $)	2020-2021	11176.9 – 65662.17	World Bank	gdp_per_capita
GOVERNMENT & ECONOMY	Human development index (HDI)	Summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living	2021	0.75 – 0.96 (full range 1-100, with higher values indicating a higher level of development)	UNDP, Human Development Report	human_development_index
GOVERNMENT & ECONOMY	Inequality-adjusted Human Development Index (IHDI)	IHDI adjusts the Human Development Index (HDI) for inequality in the distribution of each dimension across the population	2021	0.58 – 0.91 (full range 1-100, with higher values indicating a higher level of development adjusted for inequality)	UNDP, Human Development Report	IHDI
GOVERNMENT & ECONOMY	Gini index	Income inequality between individuals or households within an economy	2010-2020	24.40 – 48.90 (full range 1-100, with higher values indicating higher within population inequality)	UNDP, Human Development Report	Gini
GOVERNMENT & ECONOMY	Government Effectiveness	A measure of the quality of public services, civil service, policy formulation and implementation; including government investment in	2020-2021	-0.46 – 2.00 (full range -2.5 (less effective) to 2.5 (more effective))	Worldwide Governance Indicators (WGI)	Government_Effectiveness

		improvement and maintenance of these services				
GOVERNMENT & ECONOMY	Government revenue	Money received by a government from taxes and non-tax sources to enable it to undertake public expenditure (% of GDP)	2020-2021	14.94 – 59.25 (full range: 0-100)	The Organization for Economic Co-operation and Development (OECD) & International Monetary Fund (IMF)	Gov_rev1 , Gov_rev2, Gov_rev3
HEALTH CARE RESOURCES	Hospital beds per thousand population	Hospital bed density per 1,000 population	2019 or last available year	1.59 – 7.46	The Organization for Economic Co-operation and Development (OECD) & World Bank	hospital_beds_per_thousand1 , hospital_beds_per_thousand2
HEALTH CARE RESOURCES	Total nursing personnel	Total number of nurses (per 10,000 population)	2019 or last available year	16.46 – 75.03 19.89 – 186.22	WHO NHWA Data Platform - December 2022 update.	Nursing.Personnel.Total
HEALTH CARE RESOURCES	Total medical doctors	Total number of medical doctors (per 10,000 population)	2019 or last available year	19.89 – 186.22	WHO NHWA Data Platform - December 2022 update.	Medical.Doctors.Total
HEALTH CARE RESOURCES	Universal Health Coverage	% population coverage of essential health services (defined as the average coverage of essential services based on tracer interventions that include reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases and service	2020	55.95 – 99.90 (full range: 0 – 100, with 100 being full population coverage)	The Institute for Health Metrics and Evaluation (IHME)	uhc

		capacity and access, among the general and the most disadvantaged population)				
HEALTH CARE RESOURCES	Completeness of vital registration	Completeness of vital registration systems as assessed in 2019	2019	64.40 – 100.00	GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019.	Completeness
HEALTH CARE RESOURCES	Healthcare Access and Quality Index (HAQ)	Index based on death rates from 32 causes of death that could be avoided by timely and effective medical care (also known as 'amenable mortality')	2019	52.97 – 90.40 (full range: 0-100, with higher values indicating better healthcare access and quality)	Global Burden of Disease Study 2019 (GBD 2019)	HAQ
		Pandemic Related Variables				
POPULATION	Weekly incidence of COVID-19	Number of COVID-19 new cases per week per 1,000 population	2020-2021	0.002 – 230.6	Our World in Data	COVID19 new cases
POLICY	Stringency index	Mean stringency index per week	2020-2021	0 – 100 (full range: 0 – 100, with higher values indicating more stringent control measures)	Blavatnik School of Government, University of Oxford	stringency_index
HEALTH RESOURCES	Fully vaccinated	People fully vaccinated per hundred each	2020-2021	0.00 – 79.94	Our World in Data	fully_vaccinated_%

		week				

Table S4. Cumulative observed and expected ASMRs per 100,000 population for 2020; total population.

Country	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed-Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)
Australia	371.7	369.5	364.2	374.9	2.2	7.5	-3.2	0.6
Austria	499.5	452.5	443.9	461.2	47.0 ↑	55.6	38.3	10.4
Belgium	538.4	457.3	449.4	465.2	81.1 ↑	89.0	73.2	17.7
Brazil	666.2	578.2	571.5	584.8	88.0 ↑	94.7	81.4	15.2
Cyprus	410.8	386.8	373.7	400.0	24.0 ↑	37.1	10.7	6.2
Denmark	447.3	444.4	438.6	450.2	3.0	8.8	-2.9	0.7
England and Wales	521.4	449.3	440.8	457.9	72.1 ↑	80.6	63.5	16.0
Estonia	639.0	607.6	594.1	621.2	31.3↑	44.9	17.7	5.2
France	457.6	416.2	410.6	421.9	41.3 ↑	46.9	35.7	9.9
Georgia	864.7	770.6	754.4	786.8	94.2 ↑	110.3	77.9	12.2
Greece	577.5	536.6	527.1	546.2	40.8 ↑	50.3	31.3	7.6
Israel	432.2	399.9	394.3	405.6	32.3 ↑	37.9	26.5	8.1
Italy	479.8	428.9	421.5	436.4	50.9 ↑	58.4	43.4	11.9
Kazakhstan	770.8	620.2	610.0	630.4	150.6 ↑	160.8	140.3	24.3
Mauritius	663.9	694.7	678.1	711.4	-30.8 ↓	-14.2	-47.6	-4.4
Northern Ireland	512.3	465.2	451.6	478.9	47.1 ↑	60.7	33.4	10.1
Norway	395.4	387.6	382.1	393.1	7.8 ↑	13.3	2.3	2.0
Peru	651.9	378.9	373.0	384.7	273.0 ↑	278.8	267.1	72.1
Poland	666.5	576.6	568.5	584.7	89.9 ↑	97.9	81.8	15.6
Slovenia	523.3	456.0	446.5	465.7	67.2 ↑	76.8	57.6	14.7

Spain	521.7	439.9	433.7	446.3	81.7 ↑	88.0	75.4	18.6
Sweden	395.6	352.3	347.1	357.5	43.4 ↑	48.5	38.2	12.3
Ukraine	699.5	614.1	565.6	664.0	85.4 ↑	133.9	35.5	13.9
USA	651.5	551.0	544.5	557.5	100.5 ↑	107.0	94.0	18.2

*For all countries, the sum of observed and expected deaths is up to week 52, with the exception of England & Wales (starting from week 2 up to week 51), Kazakhstan and Mauritius (starting from week 2 up to week 52), Northern Ireland (up to week 50), and Slovenia (up to 51).
↑ Indicates statistically significant excess all-cause mortality using the sum of deaths for 2020.
↓ Indicates a statistically significant reduction all-cause mortality using the sum of deaths for 2020.
Due to the variability in the provided age groupings by countries, age-standardised mortality values are not entirely comparable between countries and direct comparisons between countries should be avoided.

Table S5. Cumulative observed and expected ASMRs per 100,000 population for 2021; total population.

Country	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed-Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)
Australia	373.5	361.7	356.4	367.0	11.8 ↑	17.1	6.5	3.3
Austria	486.8	447.7	439.1	456.4	39.1 ↑	47.7	30.4	8.7
Belgium	471.3	447.7	439.9	455.5	23.7 ↑	31.5	15.8	5.3
Brazil	742.3	569.8	563.2	576.4	172.6 ↑	179.2	165.9	30.3
Cyprus	434.5	381.2	368.2	394.5	53.2 ↑	66.3	40.0	14.0
Denmark	452.5	440.5	434.7	446.4	12.0 ↑	17.8	6.1	2.7
England and Wales	500.9	441.8	433.3	450.4	59.0 ↑	67.5	50.5	13.4
Estonia	721.4	596.2	582.7	609.8	125.2↑	138.7	111.6	21.0
France	439.0	406.9	401.3	412.5	32.2 ↑	37.8	26.5	7.9
Georgia	1006.5	749.8	733.8	765.9	256.8 ↑	272.7	240.6	34.2
Greece	628.3	535.1	525.6	544.7	93.2 ↑	102.7	83.5	17.4
Israel	434.1	389.5	383.9	395.2	44.5 ↑	50.2	38.9	11.4
Italy	444.9	414.1	406.7	421.5	30.8 ↑	38.2	23.4	7.4
Kazakhstan	961.5	622.8	612.6	633.2	338.7 ↑	349.0	328.3	54.4
Mauritius	646.6	700.5	683.7	717.4	-53.9 ↓	-37.1	-70.8	-7.7
Northern Ireland	512.8	457.5	443.9	471.2	55.3 ↑	68.9	41.6	12.1
Norway	393.3	377.3	371.9	382.8	16.0 ↑	21.4	10.5	4.2
Peru	725.3	390.4	384.3	396.5	334.9 ↑	341.0	328.8	85.8
Poland	708.5	568.5	560.4	576.6	140.0 ↑	148.1	131.9	24.6
Slovenia	500.8	448.0	438.5	457.6	52.8 ↑	62.3	43.2	11.8

Spain	468.9	433.1	426.9	439.5	35.8 ↑	42.0	29.4	8.3
Sweden	360.7	338.7	333.7	343.9	22.0 ↑	27.1	16.8	6.5
Ukraine	853.2	587.2	539.5	636.2	266.0 ↑	313.7	216.9	45.3
USA	658.6	546.2	539.7	552.7	112.4 ↑	118.9	105.9	20.6

*For all countries, the sum of observed and expected deaths is up to week 52, with the exception of England & Wales (starting from week 2 up to week 51), Kazakhstan and Mauritius (starting from week 2 up to week 52), Northern Ireland (up to week 50), and Slovenia (up to 51).
↑ Indicates statistically significant excess all-cause mortality using the sum of deaths for 2021.
↓ Indicates a statistically significant reduction all-cause mortality using the sum of deaths for 2021.
Due to the variability in the provided age groupings by countries, age-standardised mortality values are not entirely comparable between countries and direct comparisons between countries should be avoided.

Table S6. Cumulative observed and expected ASMRs per 100,000 population for the years 2020 and 2021 together; total population.

Country	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed-Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)
Australia	372.6	365.6	361.9	369.4	7.0↑	10.7	3.2	1.9
Austria	493.1	450.1	444.0	456.3	43.0↑	49.1	36.9	9.6
Belgium	504.9	452.5	446.9	458.0	52.4↑	57.9	46.8	11.6
Brazil	704.3	574.0	569.3	578.7	130.3↑	135.0	125.6	22.7
Cyprus	422.6	384.0	374.7	393.4	38.6↑	47.9	29.3	10.1
Denmark	449.9	442.5	409.1	417.1	7.5↑	40.8	32.9	1.7
England and Wales	511.1	445.6	439.5	451.6	65.6↑	71.6	59.5	14.7
Estonia	680.2	601.9	592.4	611.5	78.3↑	87.8	68.7	13.0
France	448.3	411.6	407.6	415.5	36.7↑	40.7	32.8	8.9
Georgia	935.6	760.2	748.8	771.6	175.5↑	186.8	164.0	23.1
Greece	602.9	535.9	529.1	542.7	67.0↑	73.7	60.2	12.5
Israel	433.1	394.7	390.7	398.7	38.4↑	42.4	34.4	9.7
Italy	462.3	421.5	416.3	426.8	40.8↑	46.1	35.6	9.7
Kazakhstan	866.2	621.5	614.3	628.8	244.6↑	251.9	237.4	39.4
Mauritius	655.2	697.6	685.7	709.5	-42.3↓	-30.5	-54.2	-6.1
Northern Ireland	512.5	461.3	451.7	471.0	51.2↑	60.9	41.5	11.1
Norway	374.5	359.5	355.8	363.3	14.9↑	18.6	11.2	4.1
Peru	685.1	383.6	379.4	387.8	301.5↑	305.7	297.3	78.6
Poland	696.3	582.0	576.3	587.8	114.3↑	120.1	108.6	19.6

Slovenia	512.0	452.0	445.3	458.8	60.0↑	66.8	53.2	13.3
Spain	495.3	436.5	432.1	441.0	58.7↑	63.2	54.3	13.5
Sweden	378.2	345.5	341.9	349.2	32.7↑	36.3	29.0	9.5
Ukraine	776.3	600.7	566.5	635.5	175.7↑	209.8	140.9	29.2
USA	655.0	548.6	544.0	553.2	106.5↑	111.1	101.9	19.4

*For all countries, the sum of observed and expected deaths is up to week 52, with the exception of England & Wales (starting from week 2 up to week 51), Kazakhstan and Mauritius (starting from week 2 up to week 52), Northern Ireland (up to week 50), and Slovenia (up to 51).

↑ Indicates statistically significant excess all-cause mortality using the sum of deaths for 2020 and 2021.

↓ Indicates a statistically significant reduction all-cause mortality using the sum of deaths for 2020 and 2021.

Due to the variability in the provided age groupings by countries, age-standardised mortality values are not entirely comparable between countries and direct comparisons between countries should be avoided.

Table S7. Cumulative observed and expected mortality rate for 2020 by sex.

	Males								Females							
Country	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed-Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed-Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)
Australia	418.5	415.7	410.1	421.3	2.8	8.4	-2.8	0.7	327.8	326.0	321.0	331.0	1.9	6.8	-3.1	0.6
Austria	564.4	505.4	495.5	515.3	59.0 ↑	68.8	49.0	11.7	441.5	404.7	396.1	413.5	36.7 ↑	45.4	28.0	9.1
Belgium	594.6	504.5	496.0	513.1	90.1 ↑	98.6	81.5	17.9	486.8	413.7	405.4	422.0	73.1 ↑	81.4	64.7	17.7
Brazil	824.7	702.7	695.4	710.1	122.0 ↑	129.3	114.7	17.4	528.8	468.7	462.7	474.7	60.1 ↑	66.1	54.1	12.8
Cyprus	471.4	446.0	427.8	464.4	25.4 ↑	43.6	7.0	5.7	354.9	332.6	316.9	348.7	22.3 ↑	38.0	6.3	6.7
Denmark	498.2	494.4	486.9	502.0	3.7	11.3	-3.8	0.8	399.8	397.3	391.0	403.7	2.4	8.8	-3.9	0.6
England and Wales	604.7	495.1	486.3	504.0	109.6 ↑	118.4	100.7	22.1	468.8	406.8	398.4	415.4	62.0 ↑	70.4	53.4	15.2
Estonia	812.5	776.6	755.3	798.1	35.9↑	57.2	14.5	4.6	497.7	471.3	458.4	484.3	26.4↑	39.3	13.4	5.6
France	546.0	491.3	485.2	497.5	54.7 ↑	60.8	48.5	11.1	380.6	350.0	344.8	355.1	30.7 ↑	35.8	25.5	8.8
Georgia	1180.4	1041.5	1019.3	1063.9	138.9 ↑	161.1	116.6	13.3	642.1	574.6	559.5	589.9	67.4 ↑	82.6	52.2	11.7
Greece	654.9	610.0	599.7	620.4	44.8 ↑	55.2	34.4	7.3	503.9	466.9	457.1	476.8	37.0 ↑	46.8	27.1	7.9
Israel	492.2	447.8	440.1	455.6	44.3 ↑	52.1	36.6	9.9	378.7	356.3	349.7	363.0	22.4 ↑	29.0	15.7	6.3
Italy	535.7	472.9	465.5	480.4	62.8 ↑	70.3	55.3	13.3	431.1	389.8	382.3	397.5	41.3 ↑	48.9	33.7	10.6
Kazakhstan	1009.9	791.4	777.8	805.1	218.5 ↑	232.1	204.8	27.6	606.6	498.5	489.1	507.9	108.1 ↑	117.5	98.7	21.7
Mauritius	816.3	826.9	801.8	852.3	-10.6	14.5	-35.9	-1.3	522.6	571.3	553.1	589.6	-48.7 ↓	-30.5	-67.0	-8.5
Norway	420.3	408.5	401.3	415.7	11.8 ↑	19.0	4.5	2.9	370.3	365.8	359.0	372.7	4.5	11.3	-2.4	1.2
Peru	820.0	425.2	418.4	431.9	394.8 ↑	401.6	388.1	92.9	497.9	335.5	329.7	341.4	162.3 ↑	168.2	156.5	48.4
Poland	847.1	718.9	709.4	728.5	128.1 ↑	137.6	118.6	17.8	515.5	453.9	446.6	461.2	61.6 ↑	68.9	54.2	13.6
Slovenia	594.4	516.8	501.7	532.0	77.6 ↑	92.7	62.4	15.0	461.7	398.3	387.6	409.0	63.4 ↑	74.1	52.7	15.9

Spain	607.0	513.2	506.6	519.8	93.8 ↑	100.4	87.2	18.3	445.8	374.5	368.1	380.9	71.3 ↑	77.7	64.8	19.0
Sweden	433.1	377.1	371.6	382.6	56.0 ↑	61.4	50.5	14.8	359.9	328.0	322.8	333.2	31.9 ↑	37.1	26.7	9.7
Ukraine	1278.4	1113.8	1007.0	1224.3	164.6 ↑	271.5	54.2	14.8	595.4	565.5	503.2	630.2	29.8	92.2	-34.9	5.3
USA	748.7	627.3	620.4	634.3	121.4 ↑	128.3	114.4	19.3	558.4	478.0	472.0	484.1	80.4 ↑	86.4	74.3	16.8

*For all countries, the sum of observed and expected deaths is up to week 52, with the exception of England & Wales (starting from week 2 up to week 51), Kazakhstan and Mauritius (starting from week 2 up to week 52), and Slovenia (up to 51).
↑ Indicates statistically significant excess all-cause mortality using the sum of deaths for 2020.
↓ Indicates a statistically significant reduction all-cause mortality using the sum of deaths for 2020.
Due to the variability in the provided age groupings by countries, age-standardised mortality values are not entirely comparable between countries and direct comparisons between countries should be avoided.

Table S8. Cumulative observed and expected mortality rate for 2021 by sex.

	Males								Females							
Country	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed-Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed-Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)
Australia	418.5	408.5	402.9	414.1	10.0 ↑	15.6	4.4	2.5	331.2	317.6	312.7	322.6	13.6 ↑	18.6	8.7	4.3
Austria	555.7	500.7	490.8	510.6	55.0 ↑	64.9	45.0	11.0	425.0	399.9	391.3	408.7	25.1 ↑	33.7	16.3	6.3
Belgium	534.5	492.9	484.4	501.4	41.6 ↑	50.1	33.1	8.4	414.0	405.8	397.6	414.1	8.2	16.4	-0.1	2.0
Brazil	906.3	691.8	684.5	699.1	214.5 ↑	221.8	207.2	31.0	599.5	462.7	456.7	468.7	136.8 ↑	142.8	130.8	29.6
Cyprus	498.8	440.3	422.1	458.7	58.6 ↑	76.8	40.1	13.3	376.1	327.1	311.4	343.1	49.0 ↑	64.8	33.1	15.0
Denmark	501.2	491.9	484.4	499.5	9.2 ↑	16.8	1.6	1.9	407.2	392.3	386.0	398.7	14.9 ↑	21.2	8.5	3.8
England and Wales	587.4	489.4	480.5	498.3	98.0 ↑	106.8	89.1	20.0	447.5	398.0	389.6	406.5	49.5 ↑	57.9	41.0	12.4
Estonia	925.0	760.1	739.0	781.5	164.9↑	186.1	143.5	21.7	557.2	463.5	450.6	476.4	93.7↑	106.5	80.7	20.2
France	526.6	477.9	471.9	484.0	48.7 ↑	54.8	42.6	10.2	362.3	343.8	338.6	349.0	18.5 ↑	23.7	13.4	5.4
Georgia	1341.8	1020.5	998.4	1042.7	321.4 ↑	343.5	299.2	31.5	773.3	555.5	540.5	570.6	217.7 ↑	232.7	202.6	39.2
Greece	720.1	606.9	596.5	617.3	113.2 ↑	123.6	102.8	18.7	541.2	467.0	457.1	476.9	74.2 ↑	84.1	64.3	15.9
Israel	491.8	435.7	428.1	443.4	56.0 ↑	63.7	48.3	12.9	381.9	347.2	340.7	353.8	34.7 ↑	41.2	28.1	10.0
Italy	496.2	455.9	448.6	463.3	40.3 ↑	47.7	32.9	8.8	399.7	376.8	369.3	384.3	22.9 ↑	30.4	15.4	6.1
Kazakhstan	1244.5	793.4	779.7	807.2	451.0 ↑	464.8	437.2	56.8	765.4	501.2	491.8	510.8	264.2 ↑	273.6	254.6	52.7
Mauritius	795.7	829.1	803.8	854.7	-33.4 ↓	-8.1	-58.9	-4.0	507.9	578.6	560.2	597.2	-70.7 ↓	-52.3	-89.3	-12.2
Norway	414.2	397.6	390.5	404.8	16.6 ↑	23.7	9.4	4.2	371.9	356.2	349.4	362.9	15.8 ↑	22.5	9.0	4.4
Peru	869.5	439.0	431.9	446.0	430.5 ↑	437.5	423.4	98.1	592.9	345.1	339.0	351.2	247.9 ↑	254.0	241.7	71.8
Poland	888.8	707.3	697.8	716.9	181.4 ↑	190.9	171.9	25.7	556.0	447.8	440.5	455.2	108.2 ↑	115.5	100.8	24.2
Slovenia	588.6	504.2	489.2	519.3	84.4 ↑	99.4	69.3	16.7	425.4	392.7	382.0	403.4	32.7 ↑	43.3	21.9	8.3

Spain	552.5	505.1	498.5	511.7	47.4 ↑	53.9	40.8	9.4	394.5	368.8	362.5	375.3	25.7 ↑	32.0	19.2	7.0
Sweden	394.5	361.7	356.3	367.1	32.8 ↑	38.1	27.4	9.1	328.3	316.2	311.1	321.4	12.1 ↑	17.3	7.0	3.8
Ukraine	1363.1	1106.5	999.3	1217.3	256.7 ↑	363.9	145.9	23.2	874.3	527.9	467.5	590.8	346.4 ↑	406.8	283.6	65.6
USA	765.7	624.3	617.3	631.2	141.4 ↑	148.3	134.4	22.6	556.4	471.7	465.7	477.8	84.7 ↑	90.7	78.6	17.9

*For all countries, the sum of observed and expected deaths is up to week 52, with the exception of England & Wales (starting from week 2 up to week 51), Kazakhstan and Mauritius (starting from week 2 up to week 52), and Slovenia (up to 51).
↑ Indicates statistically significant excess all-cause mortality using the sum of deaths for 2021.
↓ Indicates a statistically significant reduction all-cause mortality using the sum of deaths for 2021.
Due to the variability in the provided age groupings by countries, age-standardised mortality values are not entirely comparable between countries and direct comparisons between countries should be avoided.

Table S9. Male to female cumulative excess ratio for 2020 and 2021 respectively.

	2020			2021		
Country	**Male Excess**	**Female Excess**	**Ratio Males:Females**	**Male Excess**	**Female Excess**	**Ratio Males:Females**
Australia	2.8	1.9	1.5	10.0	13.6	0.7*
Austria	59.0	36.7	1.6	55.0	25.1	2.2
Belgium	90.1	73.1	1.2	41.6	8.2	5.1
Brazil	122.0	60.1	2.0	214.5	136.8	1.6
Cyprus	25.4	22.3	1.1	58.6	49.0	1.2
Denmark	3.7	2.4	1.5	9.2	14.9	0.6*
England and Wales	109.6	62.0	1.8	98.0	49.5	2.0
Estonia	35.9	26.4	1.4	164.9	93.7	1.8
France	54.7	30.7	1.8	48.7	18.5	2.6
Georgia	138.9	67.4	2.1	321.4	217.7	1.5
Greece	44.8	37.0	1.2	113.2	74.2	1.5
Israel	44.3	22.4	2.0	56.0	34.7	1.6
Italy	62.8	41.3	1.5	40.3	22.9	1.8
Kazakhstan	218.5	108.1	2.0	451.0	264.2	1.7
Mauritius	-10.6	-48.7	0.2*	-33.4	-70.7	0.5*
Norway	11.8	4.5	2.6	16.6	15.8	1.1
Peru	394.8	162.3	2.4	430.5	247.9	1.7
Poland	128.1	61.6	2.1	181.4	108.2	1.7
Slovenia	77.6	63.4	1.2	84.4	32.7	2.6
Spain	93.8	71.3	1.3	47.4	25.7	1.8
Sweden	56.0	31.9	1.8	32.8	12.1	2.7
Ukraine	164.6	29.8	5.5	256.7	346.4	0.7*
USA	121.4	80.4	1.5	141.4	84.7	1.7

For all countries, the sum of observed and expected deaths is up to week 52, with the exception of England & Wales (starting from week 2 up to week 51), Kazakhstan and Mauritius (starting from week 2 up to week 52), and Slovenia (up to 51).
*Indicates females are more affected than males.

Due to the variability in the provided age groupings by countries, age-standardised mortality values are not entirely comparable between countries and direct comparisons between countries should be avoided.

Table S10. Cumulative observed and expected mortality rate for 2020 by age group.

Country	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed -Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed -Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)
					<65								65+			
Australia	136.2	135.0	131.8	138.2	1.2	4.4	-2.0	0.9	3252.3	3237.0	3204.2	3270.0	15.2	48.1	-17.7	0.5
Austria	179.8	168.5	164.9	172.1	11.4↑	14.9	7.8	6.7	4670.1	4185.9	4097.1	4275.3	484.2↑	573.0	394.7	11.6
Belgium	458.0	408.2	399.7	416.9	49.7↑	58.3	41.1	12.2	5010.0	4152.8	4072.3	4233.9	857.2↑	937.7	776.1	20.6
Brazil	315.5	272.3	267.7	276.8	43.2↑	47.8	38.7	15.9	4857.2	4206.7	4172.1	4241.4	650.5↑	685.1	615.8	15.5
Cyprus	136.7	126.0	117.4	134.8	10.7↑	19.3	1.9	8.5	3751.6	3551.4	3426.0	3678.4	200.1↑	325.5	73.2	5.6
Denmark	167.2	166.1	162.0	170.3	1.1	5.3	-3.0	0.7	4064.7	4047.7	3993.5	4102.2	17.0	71.2	-37.5	0.4
England and Wales	190.9	169.2	165.6	172.9	21.7↑	25.3	18.0	12.8	4691.9	3992.3	3906.3	4078.8	699.6↑	785.6	613.1	17.5
Estonia	292.4	261.8	250.4	273.3	30.6↑	42.0	19.1	11.7	4804.8	4717.7	4608.9	4827.2	87.2	195.9	-22.4	1.8
Georgia	393.3	355.1	347.0	363.3	38.2↑	46.4	30.0	10.8	6994.2	6170.9	6017.2	6325.9	823.3↑	977.0	668.3	13.3
Greece	1125.3	1055.5	1036.4	1074.7	69.8↑	88.9	50.6	6.6	4975.7	4596.8	4499.5	4694.8	378.9↑	476.2	280.9	8.2
Israel	109.5	107.4	104.6	110.3	2.1	5.0	-0.8	2.0	4013.3	3642.3	3584.8	3700.1	371.0↑	428.5	313.2	10.2
Italy	159.1	149.6	146.3	153.0	9.5↑	12.8	6.1	6.3	4696.0	4122.1	4043.3	4201.3	573.9↑	652.7	494.7	13.9

Northern Ireland	196.6	182.4	174.2	190.7	14.2↑	22.3	5.8	7.8	4486.4	4028.4	3902.5	4155.6	458.0↑	583.9	330.7	11.4
Norway	124.3	121.8	118.3	125.4	2.4	6.0	-1.1	2.0	3727.5	3652.4	3597.8	3707.3	75.1↑	129.7	20.2	2.1
Peru	255.9	151.3	147.9	154.8	104.6↑	108.0	101.1	69.1	4970.3	2877.3	2832.4	2922.4	2093.1↑	2138.0	2047.9	72.7
Poland	324.8	300.9	296.1	305.7	23.9↑	28.7	19.1	8.0	5396.9	4481.0	4404.9	4557.5	915.9↑	991.9	839.3	20.4
Slovenia	195.2	187.9	180.9	194.9	7.3↑	14.3	0.3	3.9	4853.7	4089.4	3996.1	4183.4	764.3↑	857.5	670.3	18.7
Spain	944.7	833.5	824.3	842.8	111.1↑	120.3	101.9	13.3	4661.5	3837.6	3771.7	3903.8	823.9↑	889.7	757.7	21.5
USA	314.9	263.4	258.9	267.9	51.5↑	56.0	47.0	19.5	4644.9	3950.1	3920.5	3979.8	694.8↑	724.4	665.1	17.6
				<70								**70+**				
Cyprus	180.8	171.3	161.4	181.4	9.5	19.4	-0.6	5.6	5028.0	4816.0	4639.6	4994.6	211.9↑	388.4	33.3	4.4
Denmark	242.6	240.5	235.8	245.3	2.1	6.9	-2.7	0.9	5090.7	5004.5	4931.8	5077.6	86.1↑	158.9	13.1	1.7
Estonia	399.5	361.9	350.0	373.9	37.6↑	49.5	25.5	10.4	5957.7	5875.4	5734.9	6017.0	82.3	222.8	-59.2	1.4
France	258.8	242.6	238.3	247.0	16.1↑	20.4	11.8	6.6	5429.7	4835.1	4755.2	4915.4	594.7↑	674.5	514.4	12.3
Georgia	522.3	466.1	456.3	475.9	56.2↑	65.9	46.4	12.1	9247.0	8306.7	8093.7	8521.5	940.3↑	1153.2	725.5	11.3
Italy	223.1	204.8	200.9	208.8	18.3↑	22.2	14.3	8.9	5907.8	5164.9	5063.2	5267.2	743.0↑	844.6	640.6	14.4
Kazakhstan	403.6	316.5	311.2	321.9	87.1↑	92.4	81.7	27.5	5292.3	4656.5	6286.9	6532.2	635.8↓	-994.6	-1239.9	13.7
Mauritius	469.5	485.7	471.8	499.8	-16.2↓	-2.3	-30.3	-3.3	8573.1	7074.6	5954.9	6380.9	1498.5↑	2618.2	2192.2	21.2
Norway	174.3	168.9	164.8	173.1	5.4	9.6	1.3	3.2	4855.0	4723.9	4648.7	4799.4	131.1↑	206.3	55.6	2.8
Peru	317.5	176.6	172.9	180.4	140.9↑	144.6	137.1	79.8	6420.7	3901.9	3840.5	3963.6	2518.8↑	2580.2	2457.1	64.6
Poland	464.0	424.4	418.8	430.2	39.6↑	45.3	33.9	9.3	7142.9	5922.0	5815.8	6028.8	1220.9↑	1327.1	1114.1	20.6
Sweden	169.3	154.8	151.4	158.3	14.5↑	17.9	11.0	9.3	5292.3	4656.5	4589.7	4723.7	635.8↑	702.7	568.6	13.7
Ukraine	1395.0	1384.0	1243.0	1530.0	11.0	152.0	-135.0	0.8	8573.1	7074.6	6491.7	7673.9	1498.5↑	2081.4	899.2	21.2

*For all countries, the sum of observed and expected deaths is up to week 52, with the exception of England & Wales (starting from week 2 up to week 51), Kazakhstan and Mauritius (starting from week 2 up to week 52), Northern Ireland (up to week 50), and Slovenia (up to 51).
↑ Indicates statistically significant excess all-cause mortality using the sum of deaths for 2021.
↓ Indicates a statistically significant reduction all-cause mortality using the sum of deaths for 2021.
Due to the variability in the provided age groupings by countries, age-standardised mortality values are not entirely comparable between countries and direct comparisons between countries should be avoided.

Table S11. Cumulative observed and expected mortality rate for the whole year 2021 by age group.

Country	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed -Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)	Observed mortality rate / 100,000 population*	Expected mortality rate / 100,000 population*	Lower limit of 95% CI of Expected mortality rate	Upper limit of 95% CI of Expected mortality rate	Difference (Observed -Expected mortality rate)	Difference using the Lower limit of 95% CI of Expected mortality rate	Difference using the Upper limit of 95% CI of Expected mortality rate	P-score (the ratio of the excess to the expected, expressed as a percentage)
	<65								65+							
Australia	132.4	133.2	130.0	136.4	-0.8	2.4	-4.0	-0.6	3313.8	3159.4	3126.7	3192.1	154.5↑	187.1	121.7	4.9
Austria	185.7	166.2	162.7	169.8	19.4↑	23.0	15.8	11.7	4482.1	4149.3	4060.4	4239.0	332.7↑	421.7	243.1	8.0
Belgium	538.8	489.6	479.5	499.8	49.2↑	59.4	39.0	10.1	4243.2	4081.0	4000.7	4161.9	162.1↑	242.5	81.3	4.0
Brazil	379.1	269.7	265.2	274.3	109.4↑	113.9	104.8	40.5	5183.4	4151.5	4116.9	4186.2	1031.9↑	1066.5	997.2	24.9
Cyprus	138.0	126.1	117.4	134.9	11.9↑	20.5	3.1	9.4	4012.1	3483.9	3358.9	3610.4	528.2↑	653.2	401.8	15.2
Denmark	164.5	161.9	157.8	166.0	2.6	6.7	-1.5	1.6	4158.6	4039.1	3984.6	4093.9	119.4↑	174.0	64.6	3.0
England and Wales	196.1	168.6	164.9	172.3	27.4↑	31.1	23.7	16.3	4401.1	3912.5	3826.9	3998.7	488.6↑	574.2	402.4	12.5
Estonia	314.0	249.8	238.7	261.1	64.2↑	75.4	52.9	25.7	5576.1	4688.5	4579.4	4798.5	887.6↑	996.7	777.6	18.9

Georgia	455.6	345.2	337.1	353.4	110.4↑	118.5	102.3	32.0	8168.7	6013.0	5860.4	6166.9	2155.7↑	2308.3	2001.8	35.9
Greece	1296.2	1053.3	1034.1	1072.6	242.9↑	262.1	223.6	23.1	5297.6	4586.9	4489.1	4685.4	710.7↑	808.5	612.2	15.5
Israel	112.4	105.0	102.2	107.9	7.3↑	10.2	4.5	7.0	4009.5	3543.0	3486.0	3600.3	466.6↑	523.6	409.2	13.2
Italy	159.0	145.2	141.8	148.5	13.9↑	17.2	10.5	9.6	4275.2	3987.4	3909.5	4065.9	287.7↑	365.7	209.3	7.2
Northern Ireland	205.9	181.3	173.1	189.7	24.5↑	32.7	16.2	13.5	4410.9	3951.3	3825.9	4078.1	459.6↑	585.0	332.8	11.6
Norway	121.7	118.9	115.4	122.4	2.8	6.3	-0.7	2.4	3733.0	3556.5	3502.3	3611.0	176.4↑	230.6	122.0	5.0
Peru	308.4	156.1	152.5	159.7	152.3↑	155.9	148.7	97.6	5285.3	2971.9	2925.0	3019.0	2313.4↑	2360.2	2266.3	77.8
Poland	357.0	296.5	291.7	301.3	60.5↑	65.3	55.7	20.4	5650.7	4412.4	4336.5	4488.8	1238.3↑	1314.2	1161.9	28.1
Slovenia	206.1	182.0	175.1	189.0	24.1↑	31.0	17.1	13.2	4503.0	4037.5	3944.2	4131.4	465.5↑	558.7	371.5	11.5
Spain	930.4	833.3	824.1	842.6	97.0↑	106.3	87.7	11.6	4078.3	3766.6	3701.0	3832.6	311.7↑	377.3	245.7	8.3
USA	345.6	263.9	259.4	268.5	81.7↑	86.2	77.2	31.0	4423.9	3891.1	3861.5	3920.7	532.8↑	562.4	503.2	13.7
	<70								**70+**							
Cyprus	189.4	170.6	160.7	180.8	18.8↑	28.7	8.7	11.0	5308.5	4707.9	4532.5	4885.5	600.6↑	776.0	423.0	12.8
Denmark	238.6	235.3	230.6	240.1	3.2	8.0	-1.5	1.4	5214.4	4924.9	4852.4	4997.8	289.5↑	362.1	216.6	5.9
Estonia	355.8	351.0	339.2	362.9	4.8	16.6	-7.1	1.4	6376.7	5832.3	5691.5	5974.3	544.4↑	685.2	402.4	9.3
France	257.8	238.1	233.8	242.4	19.7↑	24.0	15.4	8.3	5100.4	4725.2	4645.8	4805.0	375.2↑	454.6	295.4	7.9
Georgia	613.0	457.3	447.6	467.0	155.7↑	165.4	146.0	34.1	10793.0	8170.3	7957.9	8384.6	2622.7↑	2835.1	2408.4	32.1
Italy	221.4	197.3	193.4	201.2	24.1↑	28.0	20.2	12.2	5360.1	4970.0	4869.7	5071.0	390.1↑	490.4	289.1	7.8
Kazakhstan	509.2	319.2	313.8	324.6	190.0↑	195.4	184.7	59.5	9532.4	6431.2	6307.9	6555.2	3101.2↑	3224.5	2977.1	48.2
Mauritius	471.0	499.7	485.5	514.1	-28.7↓	-14.5	-43.1	-5.7	5519.3	6126.8	5914.4	6341.6	-607.4↓	-395.1	-822.3	-9.9
Norway	171.0	163.9	159.8	168.1	7.0↑	11.1	2.9	4.3	4863.9	4554.3	4480.1	4628.8	309.7↑	383.8	235.1	6.8
Peru	371.1	182.7	178.8	186.7	188.4↑	192.3	184.5	103.1	6804.7	4036.3	3972.2	4100.7	2768.4↑	2832.5	2703.9	68.6
Poland	419.2	430.6	515.1	424.9	-11.5↓	-95.9	-5.7	-2.7	7375.2	5826.4	5720.4	5933.0	1548.9↑	1654.8	1442.3	26.6

Sweden	161.2	147.0	143.7	150.4	14.2↑	17.5	10.8	9.6	4741.2	4496.7	4430.6	4563.0	244.5↑	310.6	178.2	5.4
Ukraine	2419.0	1258.8	1124.0	1398.7	1160.2↑	1295.0	1020.3	92.2	8055.7	7125.3	6536.3	7730.9	930.5↑	1519.4	324.8	13.1

*For all countries, the sum of observed and expected deaths is up to week 52, with the exception of England & Wales (starting from week 2 up to week 51), Kazakhstan and Mauritius (starting from week 2 up to week 52), Northern Ireland (up to week 50), and Slovenia (up to 51).
↑ Indicates statistically significant excess all-cause mortality using the sum of deaths for 2021.
↓ Indicates a statistically significant reduction all-cause mortality using the sum of deaths for 2021.
Due to the variability in the provided age groupings by countries, age-standardised mortality values are not entirely comparable between countries and direct comparisons between countries should be avoided.

Table S12. The mean of sociodemographic determinants of excess mortality for each country 2020-2021

	Population density	Median age	% of population aged 65+	Life Expectancy	Hypertension prevalence (2019	Diabetes prevalence (2019)	Obesity prevalence (2019)	PM2.5 air pollution	GDP	HDI	IDHI	Gini index	Government Effectiveness	Government revenue	Hospital beds per 1,000 population	Medical Doctors per 1,000 population	Nursing Personnel per 1,000 population	UHC	Completeness of vital registration systems	Healthcare Access and Quality (HAQ)
Australia	3.359	36.806	16.42	83.2	29.3	6.4	29	8.550	49261.096	0.951	0.876	34.3	1.562	35.261	3.84	41.02	136.3	89.423	100	90.18
Austria	108.0	42.669	19.31	81.193	33.8	4.6	20.1	12.478	53054.781	0.916	0.851	30.2	1.646	49.379	7.05	54.10	104.9	86.370	100	87.97
Belgium	382.7	40.823	19.32	80.795	30	3.6	22.1	77.84	50359.236	0.937	0.874	27.2	1.121	49.930	5.519	48.60	191.0	87.301	99.8	86.6
Brazil	25.58	32.616	9.448	76.084	45	8.8	22.1	12.707	14307.155	0.754	0.576	48.9	-0.449	31.53	2.09	21.42	55.13	64.828	99.3	52.97
Cyprus	134.3	37.344	14.32	81.135	30.8	8.6	21.8	17.294	40579.396	0.896	0.819	31.2	0.806	42.44	3.4	53.75	42.82	99.897	90.7	86.17
Denmark	137.8	137.753	20.17	81.551	35.9	5.3	19.7	10.029	56740.62	0.948	0.898	27.7	1.943	54.094	2.552	42.64	101.6	84.140	100	85.54
England & Wales	276.8	39.543	18.83	80.902	26.4	6.3	27.8	10.473	43481.410	0.929	0.85	35.1	1.324	39.814	2.382	31.11	85.87	67.157	100	83.34
Estonia	30.58	41.423	20.28	78.346	40.2	6.5	21.2	6.732	37300.481	0.89	0.829	30.8	1.359	39.224	4.46	38.63	91.86	82.040	100	76.45
France	117.0	41.497	21.18	82.175	29.1	5.3	21.6	11.815	43613.133	0.903	0.825	32.4	1.253	52.510	5.73	33.24	118.5	90.766	100	88.02

Georgia	54.13	36.334	14.53	73.919	44.5	5.7	21.7	22.196	14726.493	0.802	0.706	34.5	0.132	25.42	2.89	51.32	58.17	55.953	94.3	57.71
Greece	80.08	44.545	22.36	81.088	31.3	6.4	24.9	16.218	28325.790	0.887	0.791	33.1	0.441	49.877	4.18	63.06	34.28	80.140	100	83.88
Israel	408.2	29.018	11.87	82.699	29.1	8.5	26.1	21.381	40706.568	0.919	0.815	38.6	1.190	41.605	2.915	36.22	53.84	81.384	100	83.08
Italy	200.6	46.626	23.54	82.344	33.8	6.4	19.9	16.751	40497.357	0.895	0.791	35.2	0.377	47.714	3.19	40.66	62.65	88.895	100	89.6
Kazakhstan	7.071	29.515	7.898	71.370	41.9	6.6	21	13.824	25736.019	0.811	0.755	27.8	0.101	14.94	6.06	40.28	66.55	59.237	88.3	59.47
Northern Ireland	276.8	39.543	18.83	80.902	26.4	6.3	27.8	10.473	43481.410	0.929	0.85	35.1	1.324	39.814	2.381	31.12	85.88	67.157	100	83.34
Norway	17.72	39.186	17.93	83.210	30.5	3.6	23.1	6.956	64605.088	0.961	0.908	27.7	1.883	57.567	3.4	51.30	181.9	94.241	100	90.4
Peru	26.19	28.076	8.289	76.947	20.7	4.8	19.7	24.787	11845.785	0.762	0.635	43.8	-0.262	21	1.59	16.46	19.89	75.759	64.4	60
Poland	125.3	40.701	18.62	76.600	49.2	6.8	23.1	20.878	33731.175	0.876	0.816	30.2	0.326	41.849	6.19	37.14	60.27	72.656	100	73.2
Slovenia	105.2	43.055	20.32	80.532	45.3	5.8	20.2	16.024	38567.302	0.918	0.878	24.4	1.168	44.028	4.28	32.79	103.9	89.834	94.8	87.8
Spain	94.42	43.688	19.80	82.334	27.2	10.3	23.8	9.698	36940.484	0.905	0.788	34.3	0.917	42.78317416	2.95	45.77	61.04	90.006	100	89.67
Sweden	25.59	39.502	20.07	82.407	30.2	5	20.6	6.184	52472.352	0.947	0.885	29.3	1.681	49.316	2.05	70.62	203	90.361	100	90.38
Ukraine	75.44	40.638	17.30	71.185	43.1	5.6	24.1	20.310	12675.702	0.773	0.726	25.6	-0.396	36.94	7.46	29.9	62.95	63.812	100	63.05
USA	36.7	37.575	16.4	77.28	31.	10.	36.	7.409	61918.78	0.92	0.81	41.	1.32	32.660	2.8	35.5	124.	82.13	99.	80.5

	9		7	0	6	7	2			1	9	5	3			5	7	8	9	8

*Recent data from reliable sources was not available for Mauritius. Peru and Kazakhstan are included here for descriptive purposes, but were excluded from the analyses of determinants of excess mortality due to a completeness of vital registration systems of <90%.

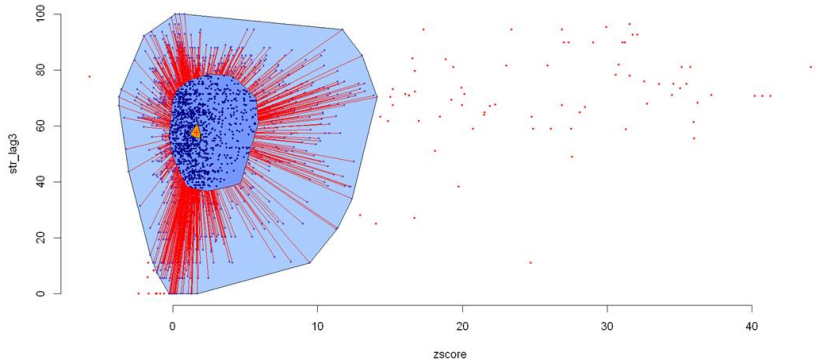

Figure S1. Bag plot of the observations in 2020 and 2021, regarding z-score and Stringency of control measures (3-week lag). In the bag plot, half of the data is in the dark blue polygon (interior polygon) and the outer polygon is used to identify outliers.

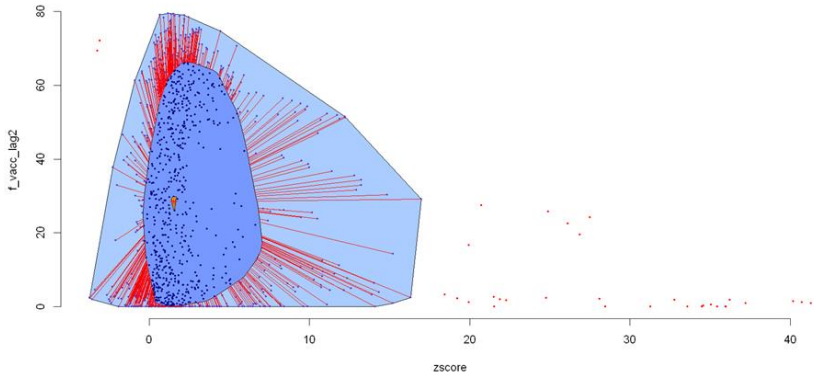

Figure S2. Bag plot of the observations in 2021, regarding z-score and fully vaccinated per 100 population (2-week lag).

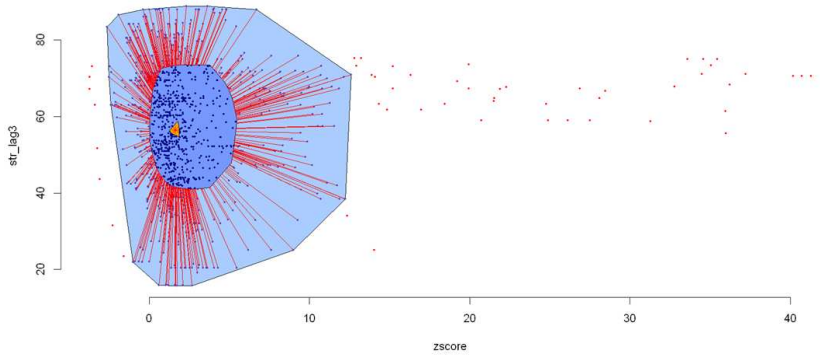

Figure S3. Bag plot of the observations in 2021, regarding z-score and Stringency of control measures (3-week lag).

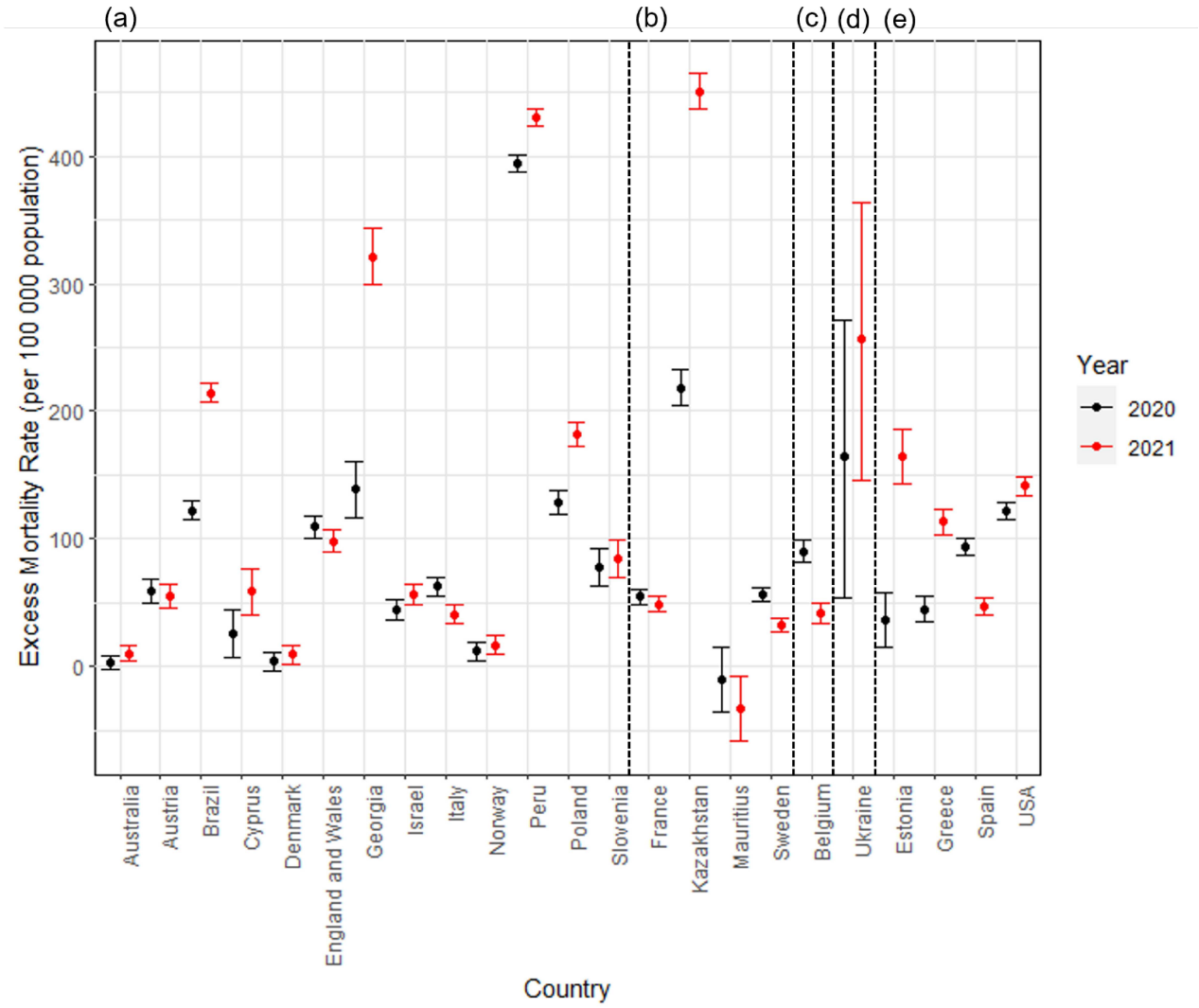
(a)
(b)
(c)
(d)
(e)
Excess Mortality Rate (per 100 000 population)
400
300
200
100
0
Year
2020
2021
Australia
Austria
Brazil
Cyprus
Denmark
England and Wales
Georgia
Israel
Italy
Norway
Peru
Poland
Slovenia
France
Kazakhstan
Mauritius
Sweden
Belgium
Ukraine
Estonia
Greece
Spain
USA
Country

Figure S4. Cumulative excess age-standardized mortality rate for males for 2020 and 2021. Plot letters correspond to the age groups in which countries have provided data and therefore the age groups used for age standardization: (a) age groups <15, 15-44, 45-64, 65+; (b) age groups <20, 20-49, 50-69, 70+; (c) age groups <45, 45-64, 65+; (d) age groups <20, 20-69, 70+; (e) age groups <15, 15-64, 65+. The plot was produced using R.

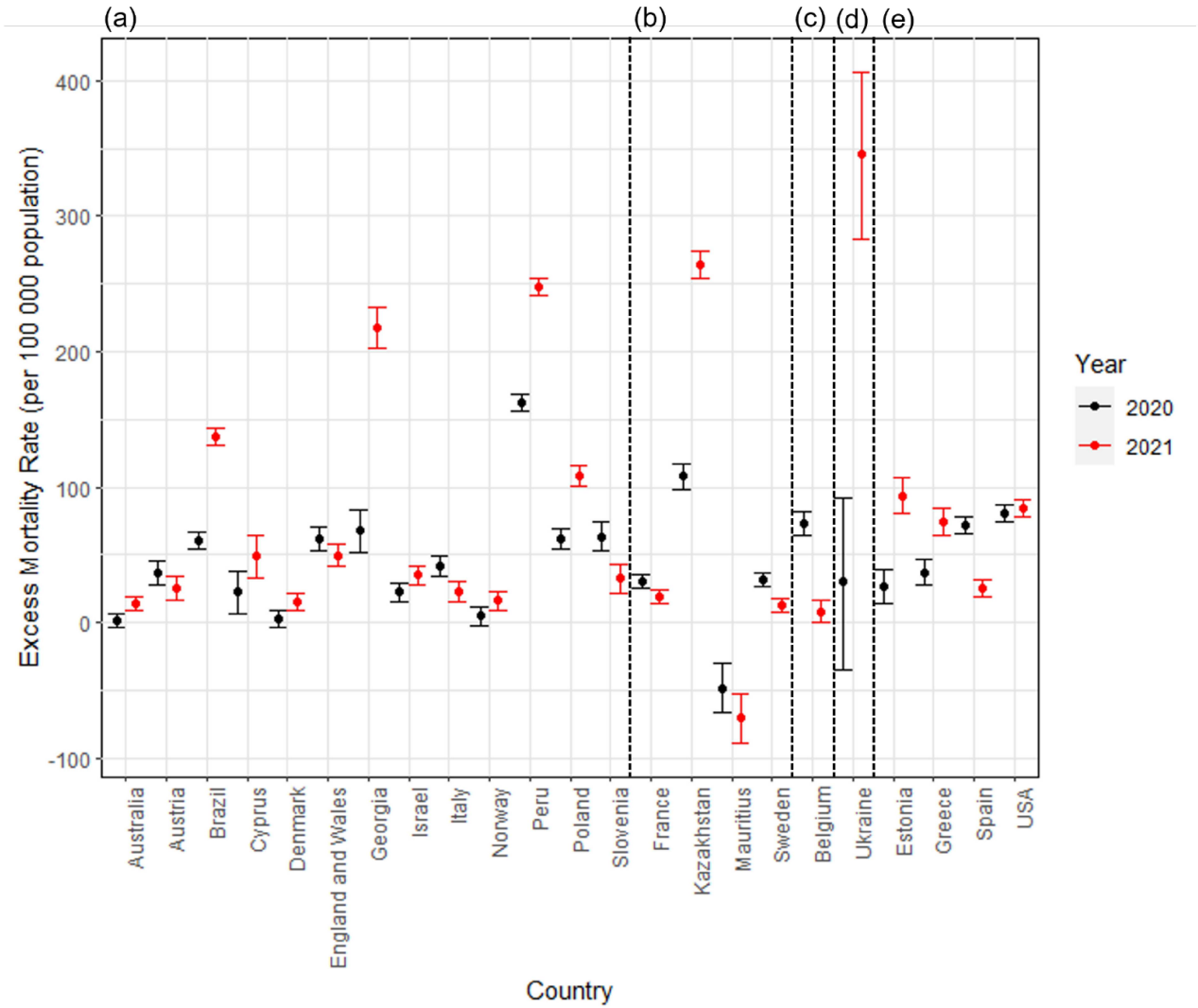
(a)
(b)
(c)
(d)
(e)
Excess Mortality Rate (per 100 000 population)
400
300
200
100
0
-100
Australia
Austria
Brazil
Cyprus
Denmark
England and Wales
Georgia
Israel
Italy
Norway
Peru
Poland
Slovenia
France
Kazakhstan
Mauritius
Sweden
Belgium
Ukraine
Estonia
Greece
Spain
USA
Country
Year
2020
2021

Figure S5. Cumulative excess age-standardized mortality rate for females for 2020 and 2021. Plot letters correspond to the age groups in which countries have provided data and therefore the age groups used for age standardization: (a) age groups <15, 15-44, 45-64, 65+; (b) age groups <20, 20-49, 50-69, 70+; (c) age groups <45, 45-64, 65+; (d) age groups <20, 20-69, 70+; (e) age groups <15, 15-64, 65+. The plot was produced using R.

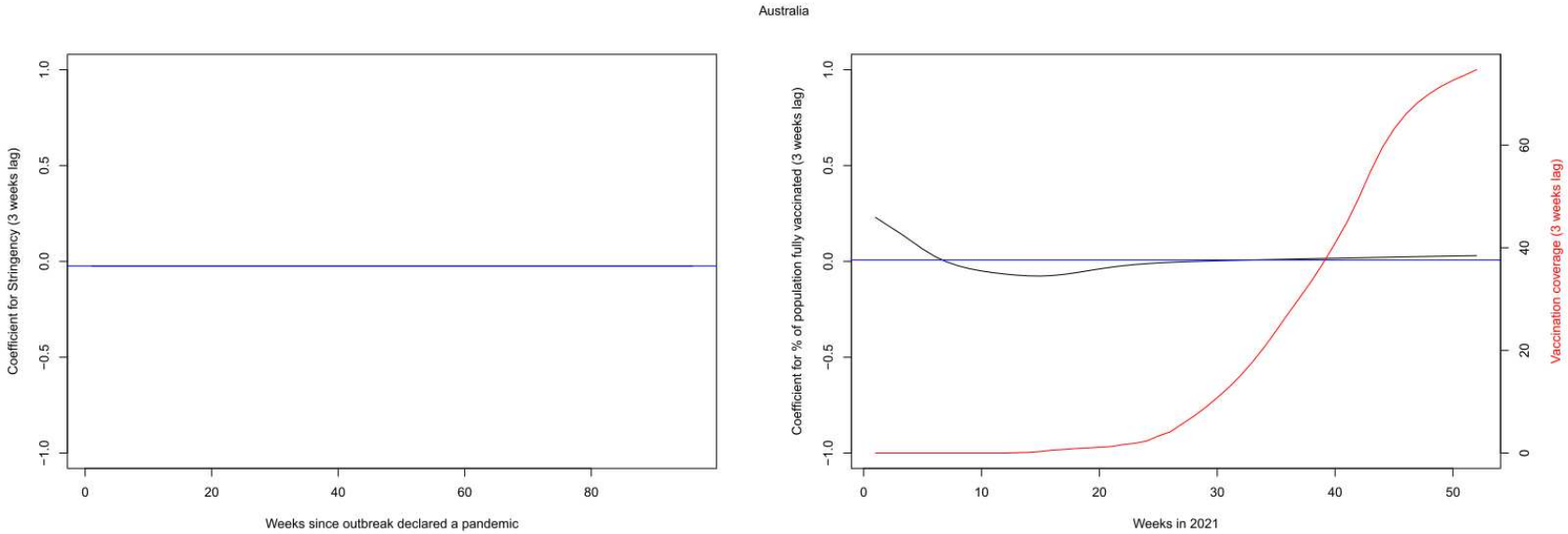

Figure S6 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Australia.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Negative coefficients throughout. NB: blue line is superimposed on the black line.

Vaccination: Coefficients drop to negative values shortly after vaccine introduction (week 15), but then increase again to reach a plateau that is positive at the end of 2021.

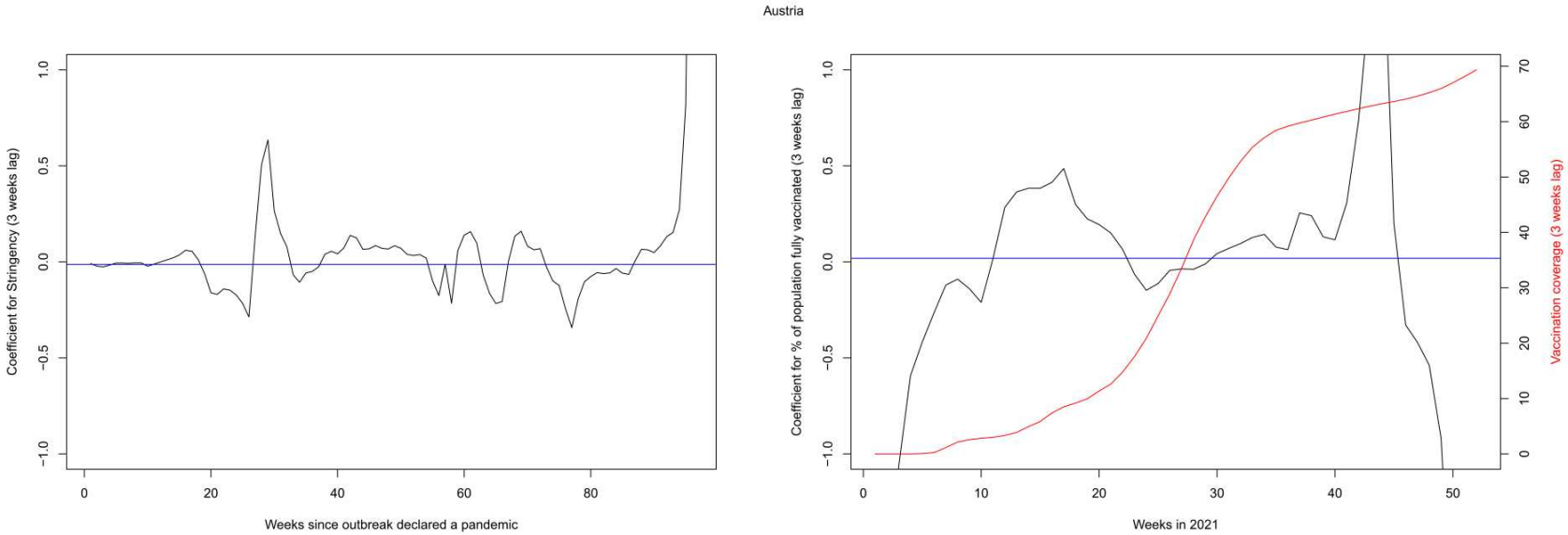

Figure S7 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Austria.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating between positive and negative values throughout 2020-2021

Vaccination: Coefficients start in the negative range. The coefficients then increase towards zero and weak positive values (weeks 15-35), but sharply increase between weeks 40-45, to drop to negative values again at the end of 2021.

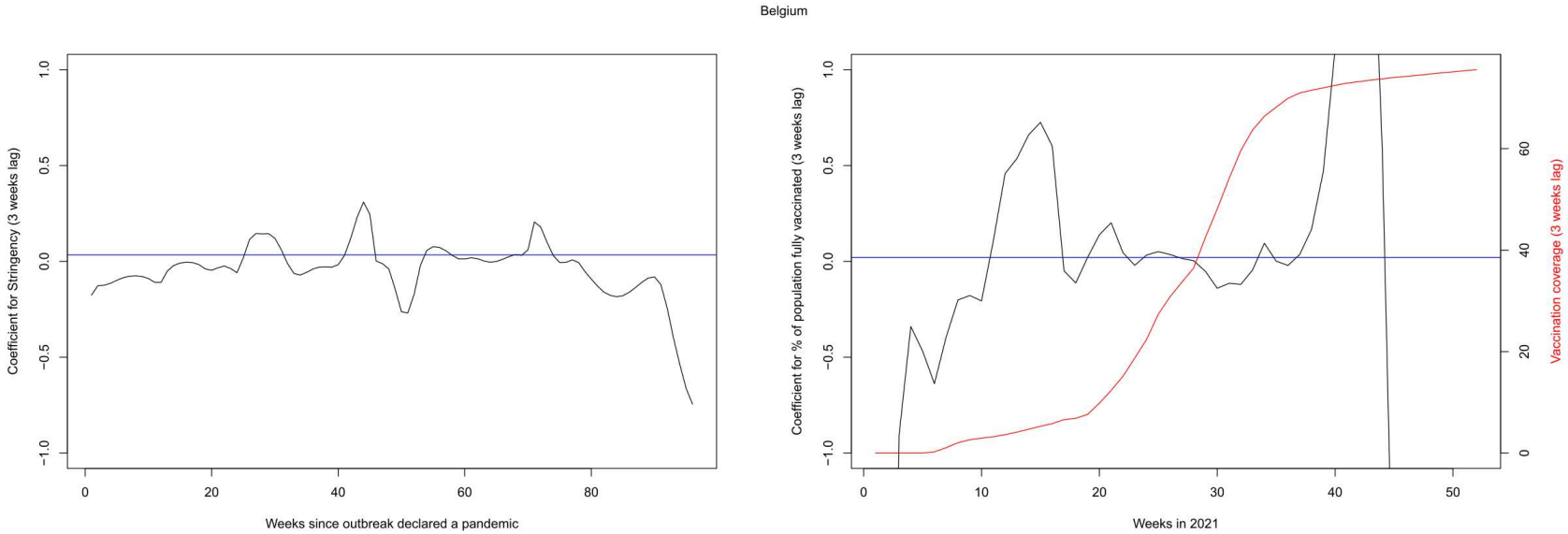

Figure S8 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Belgium.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating between positive and negative values throughout 2020-2021, but were in the negative range for most of the years.

Vaccination: Coefficients start in the negative range. The coefficients then increase towards zero and weak positive values in weeks 12-35. They then sharply increase until week 42, to drop to negative values again at the end of 2021.

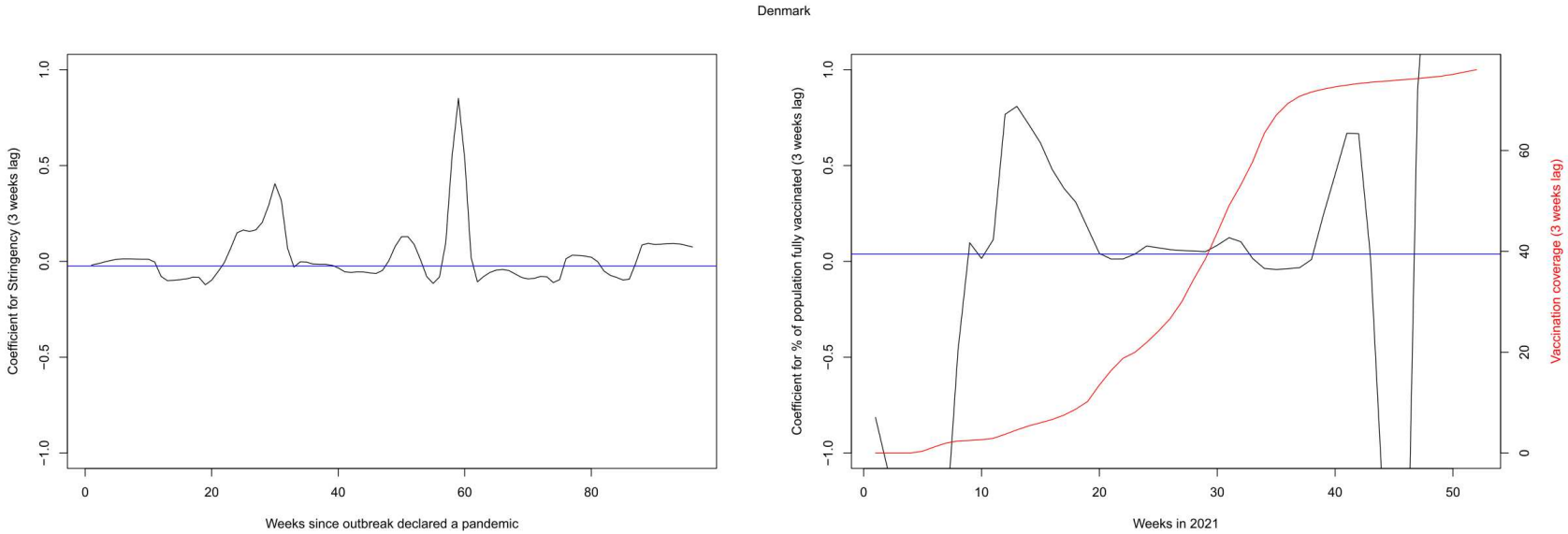

Figure S9 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Denmark.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating between positive and negative values throughout 2020-2021.

Vaccination: Coefficients start in the negative range. Then, coefficients increase towards zero (week 15). There are two sharp peaks between weeks 10-20 and weeks 38-42. The coefficients drop sharply to negative values between 42-48 weeks to increase sharply again at the end of 2021.

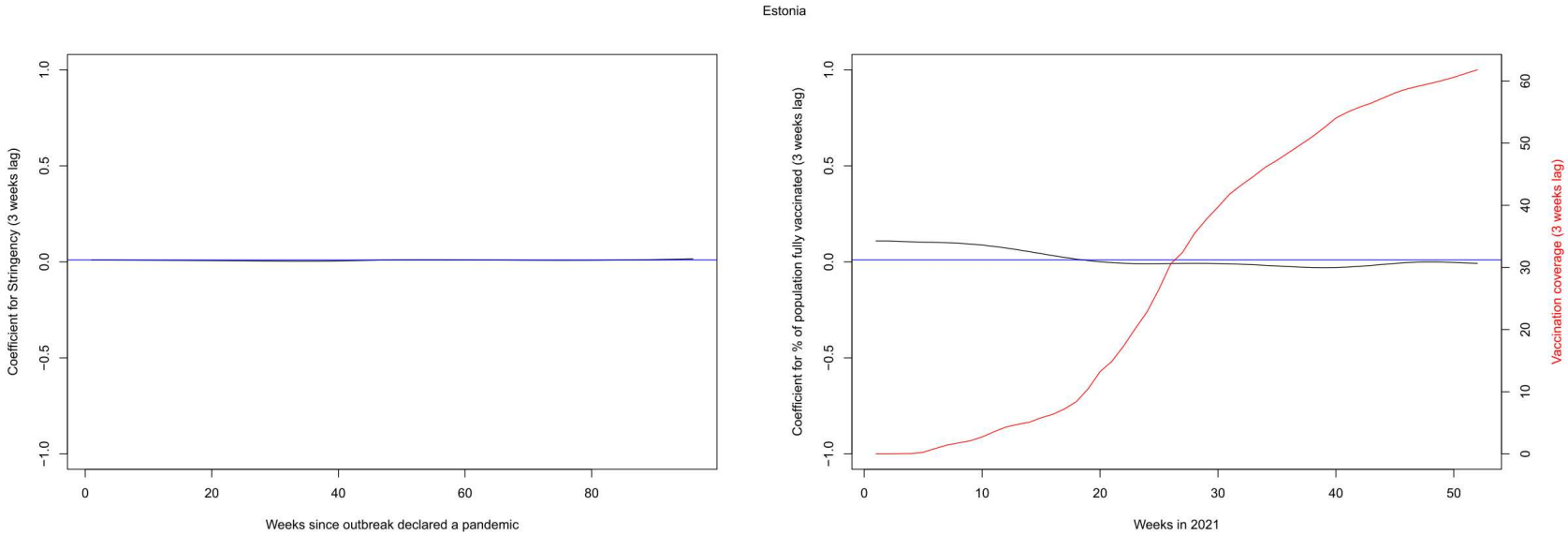

Figure S10 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Estonia.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Positive coefficient throughout,. NB: black line is superimposed by the blue line.

Vaccination: Coefficients start positive and then drop to negative values around week 20, and remain in the negative range throughout the rest of the year. Despite still negative, the coefficients are slightly attenuated between weeks 40-50.

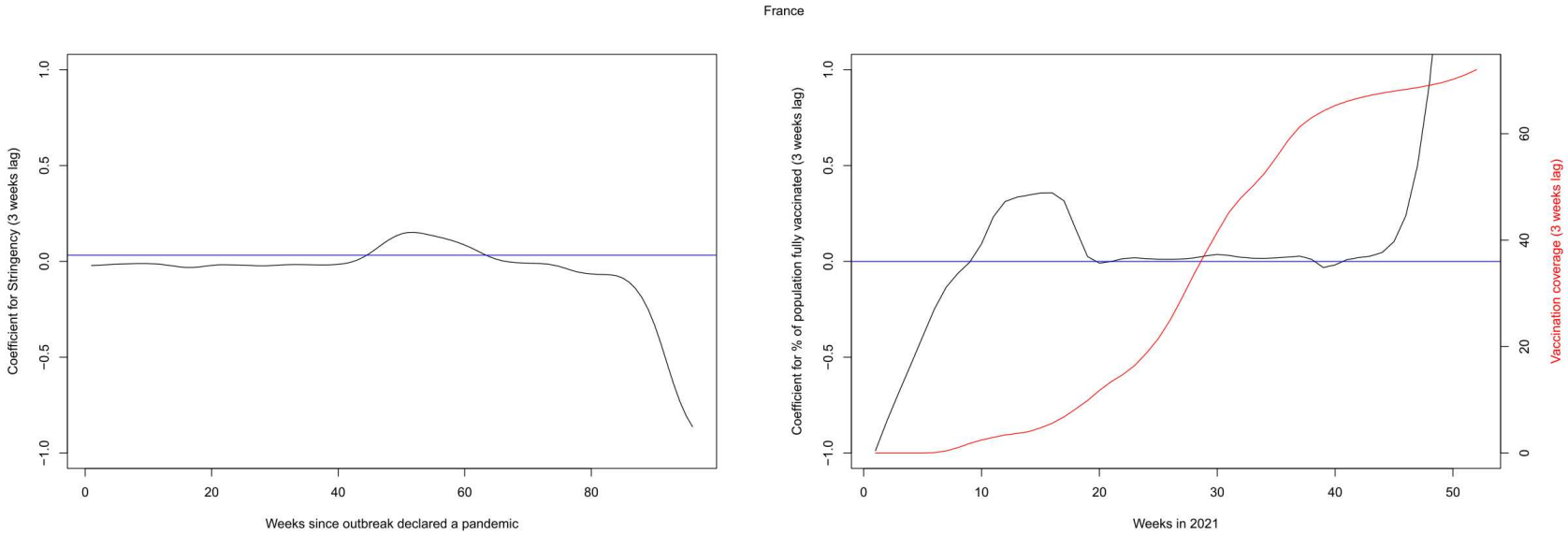

Figure S11 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for France.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients were negative for most of 2020-2021, with a brief increase to positive values in the first weeks of 2021.

Vaccination: Coefficients start in the negative range. Coefficients then increase towards zero and positive values (weeks 10-30). They then remain stable around zero until week 42 when they sharply increase and remain high until the end of 2021.

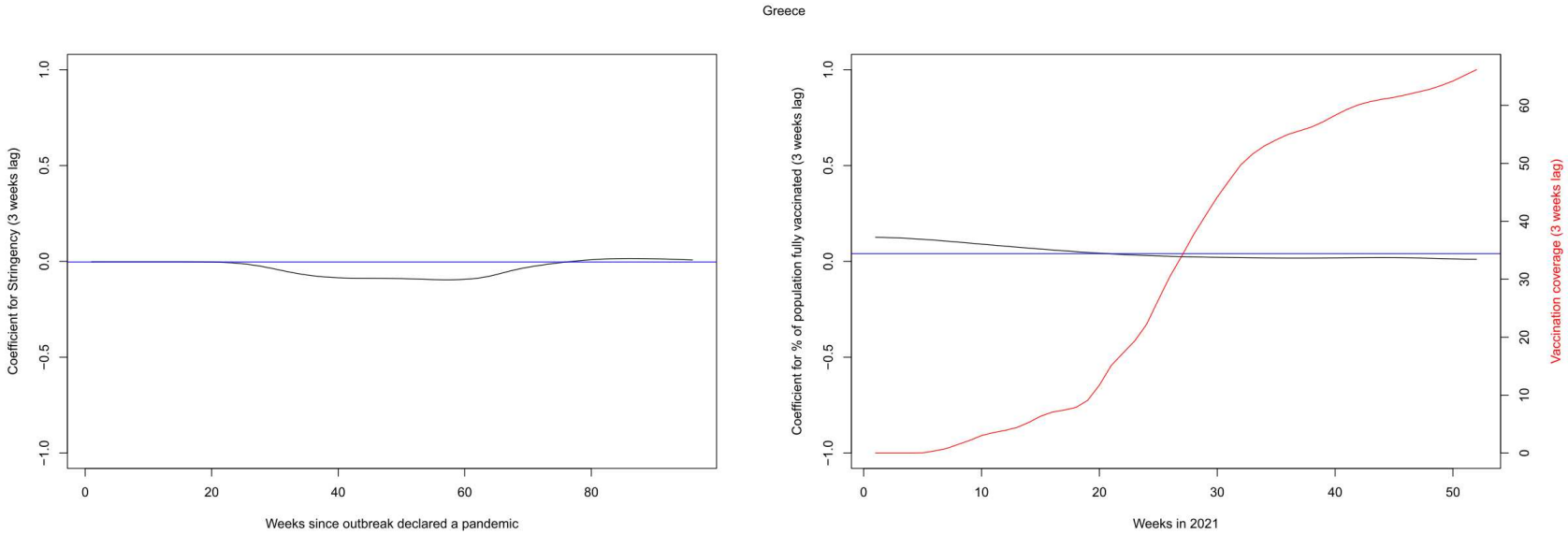

Figure S12 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Greece.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients were negative for most of 2020-2021, with a brief increase to positive values during the last weeks of 2021.

Vaccination: Coefficients were positive and dropped to zero and negative values after week 20 and remained negative until the end of the year.

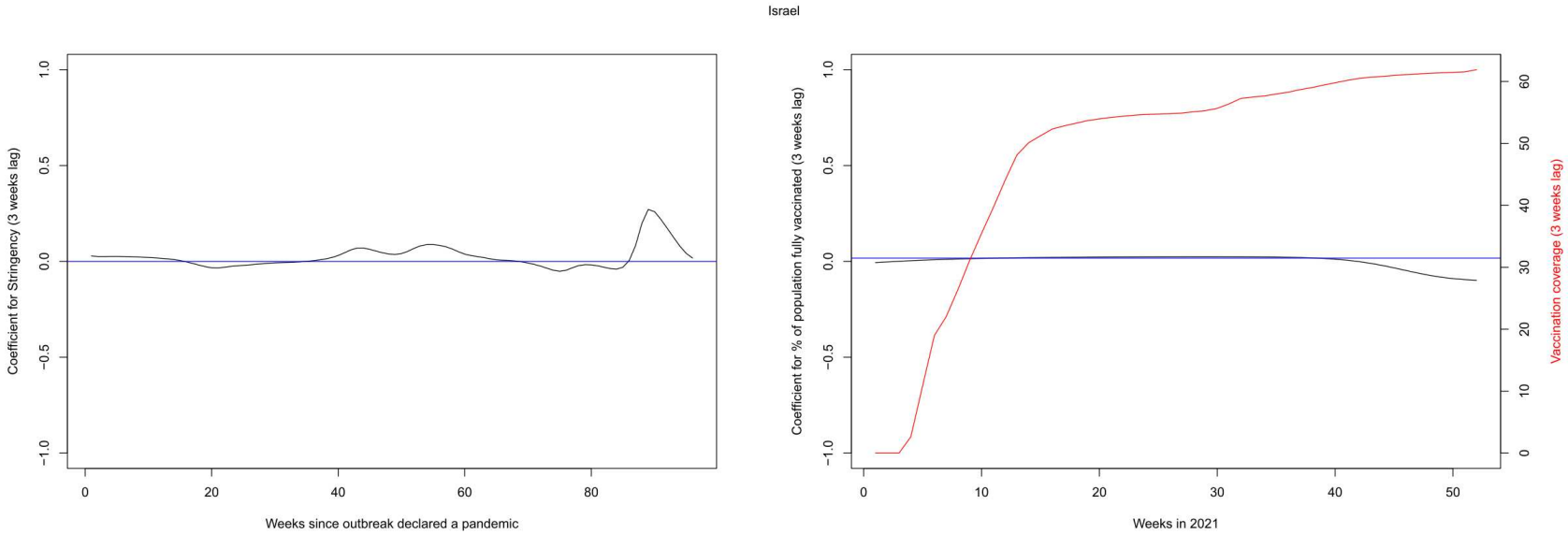

Figure S13 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Israel.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating between positive and negative values throughout 2020-2021.

Vaccination: Coefficients start in the negative range. The coefficients then increase slightly towards zero (weeks 10-35), and then drop to negative values again at the end of 2021.

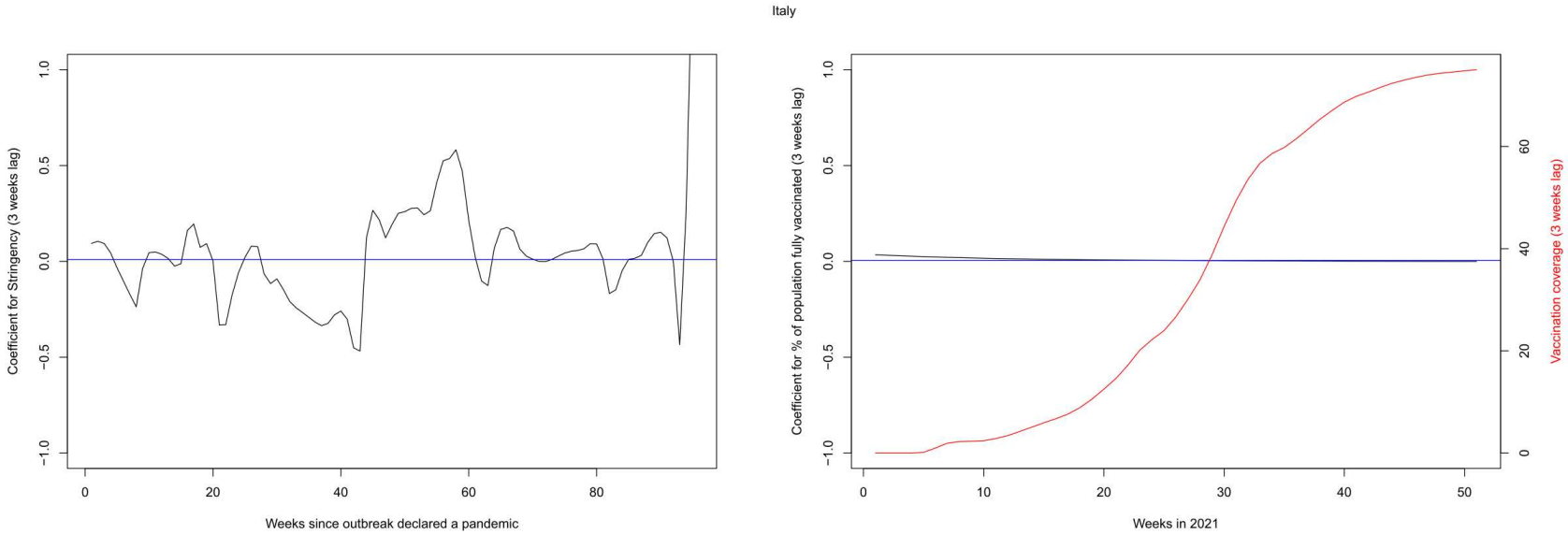

Figure S14 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Italy.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating between positive and negative values throughout 2020-2021.

Vaccination: Coefficients were positive and dropped to zero and weak negative values after week 20 and remained negative until the end of the year.

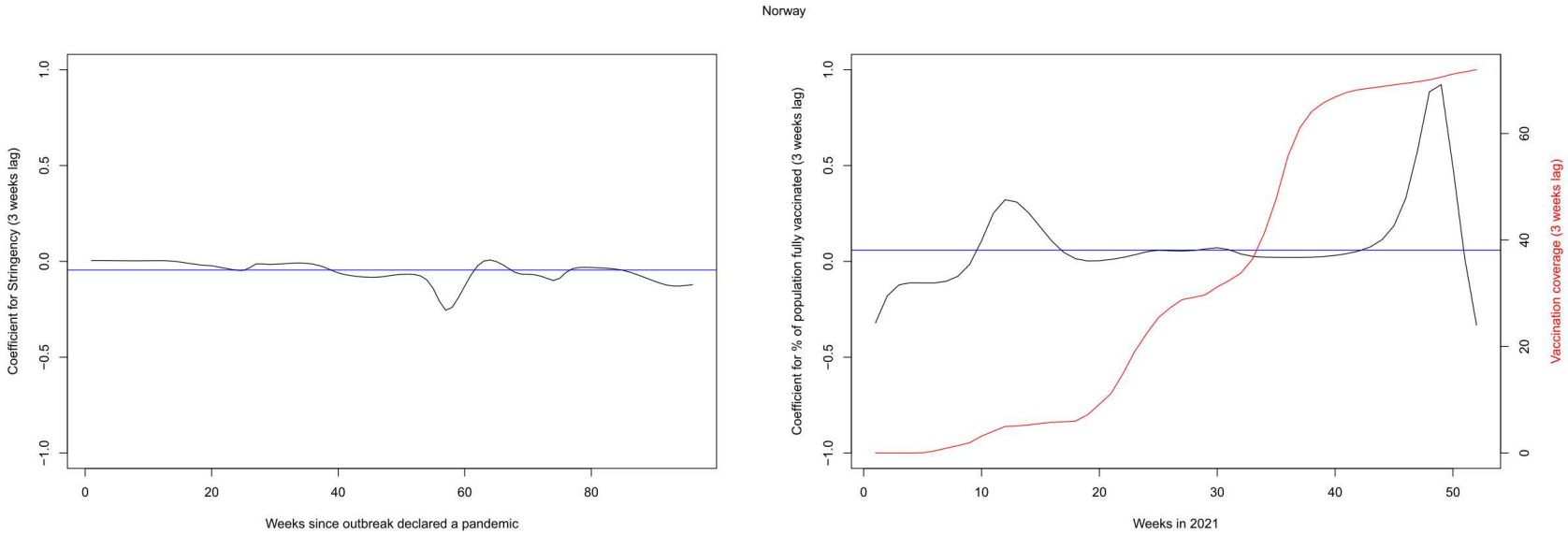

Figure S15 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Norway.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating but were negative values throughout 2020-2021

Vaccination: Coefficients start in the negative range. Then, coefficients increase towards zero (week 10), where they largely remain with the exception of two sharp peaks between weeks 10-20 and weeks 40-50.

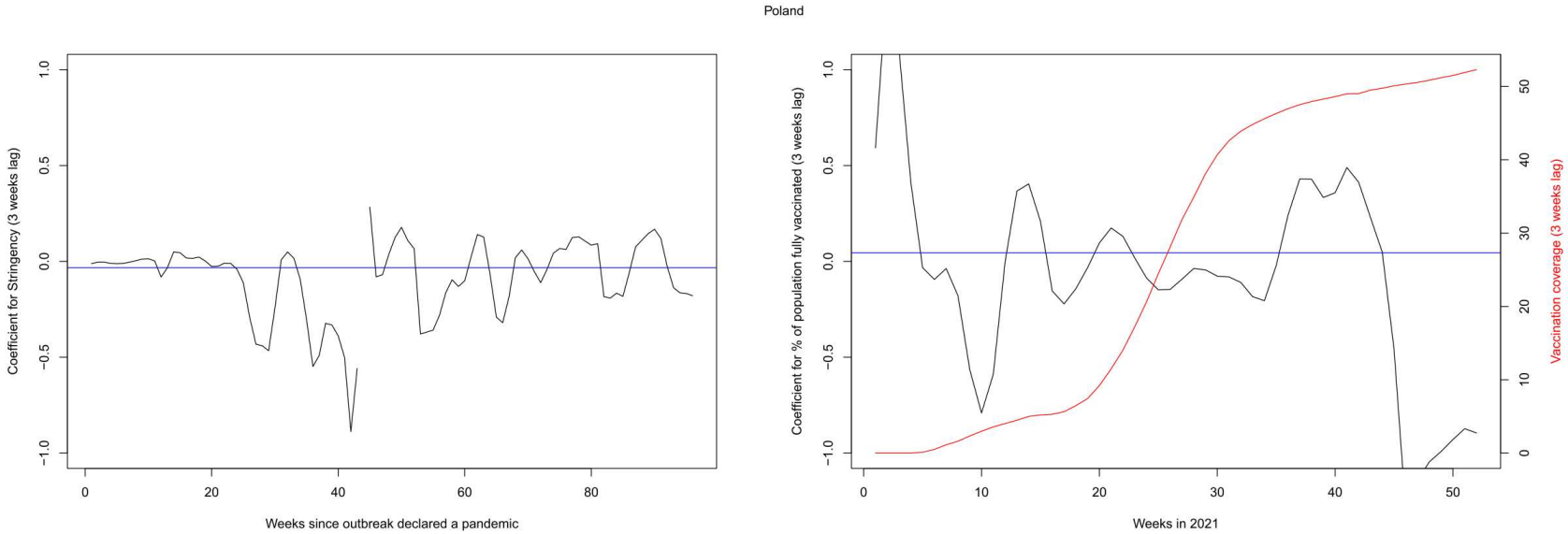

Figure S16 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Poland.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating between positive and negative values throughout 2020-2021, but were in the negative range for most of the years.

Vaccinations: Coefficients start in the positive range and from week 5 onwards fluctuate between positive and negative values. There is a brief sustained increase in the coefficients between weeks 35-45, but the coefficients then drop back to negative values.

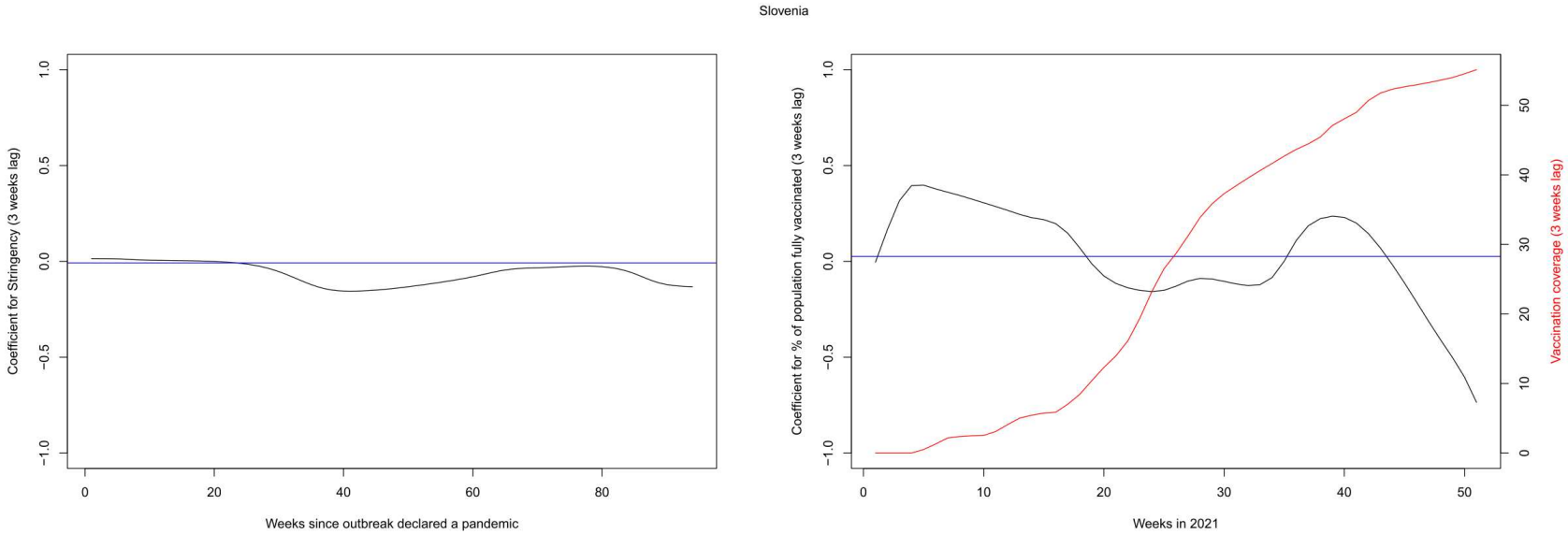

Figure S17 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Slovenia.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating throughout 2020-2021, but were in the negative range for most of the years.

Vaccinations: Coefficients start in the positive range but drop to negative values between weeks 20-35. There is a brief sustained increase in the coefficients between weeks 35-45, but the coefficients then drop back to negative values.

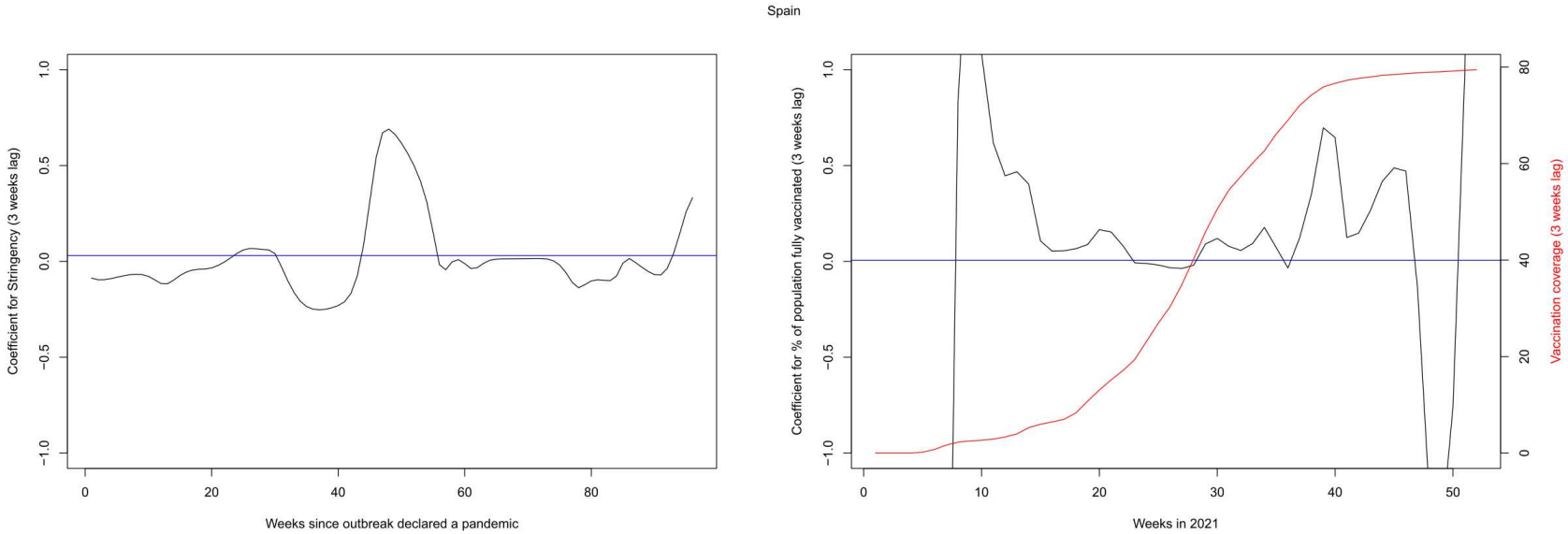

Figure S18 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Spain.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating throughout 2020-2021, but were in the negative range for most of the years.

Vaccination: Coefficients increase towards zero and positive values (weeks 10-35), but then decrease and sharply increase to positive values again at the end of 2021.

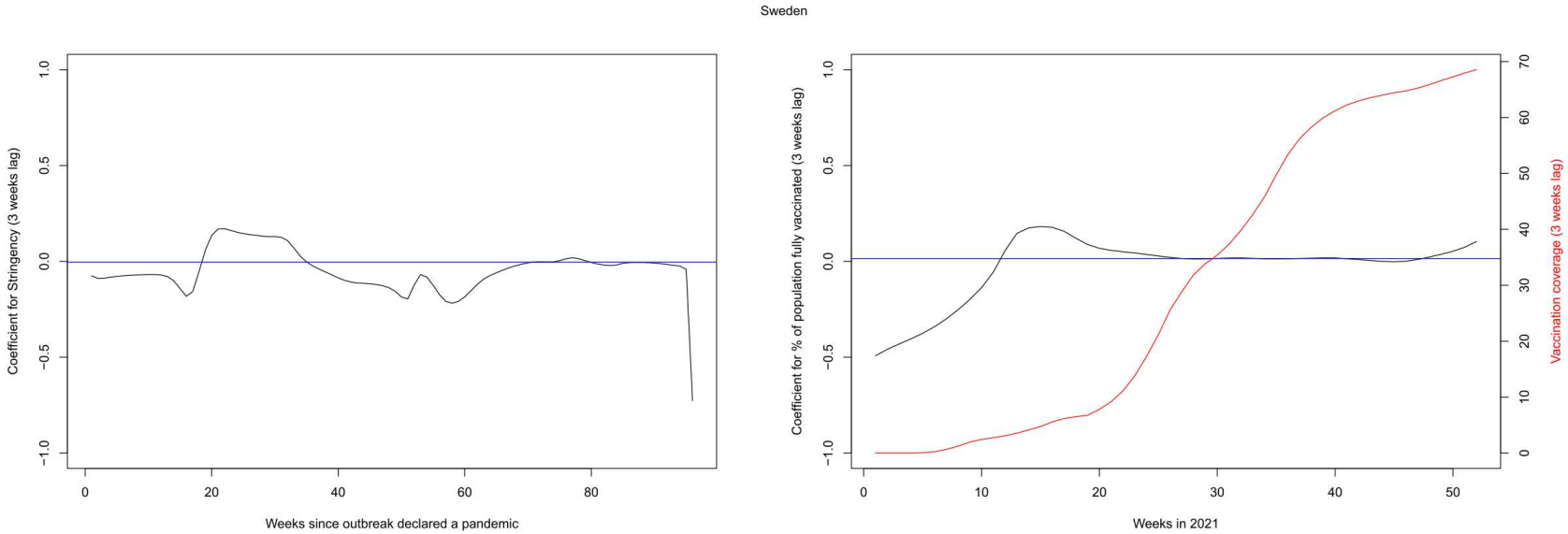

Figure S19 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Sweden.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating throughout 2020-2021, but were in the negative range for most of the years.

Vaccination: Coefficients start in the negative range indicating that the first vaccinations, that prioritised older and vulnerable portions of the population, managed to mitigate excess mortality. Then, coefficients increase towards zero and weak positive values (week 15), where they remain for the rest of the year.

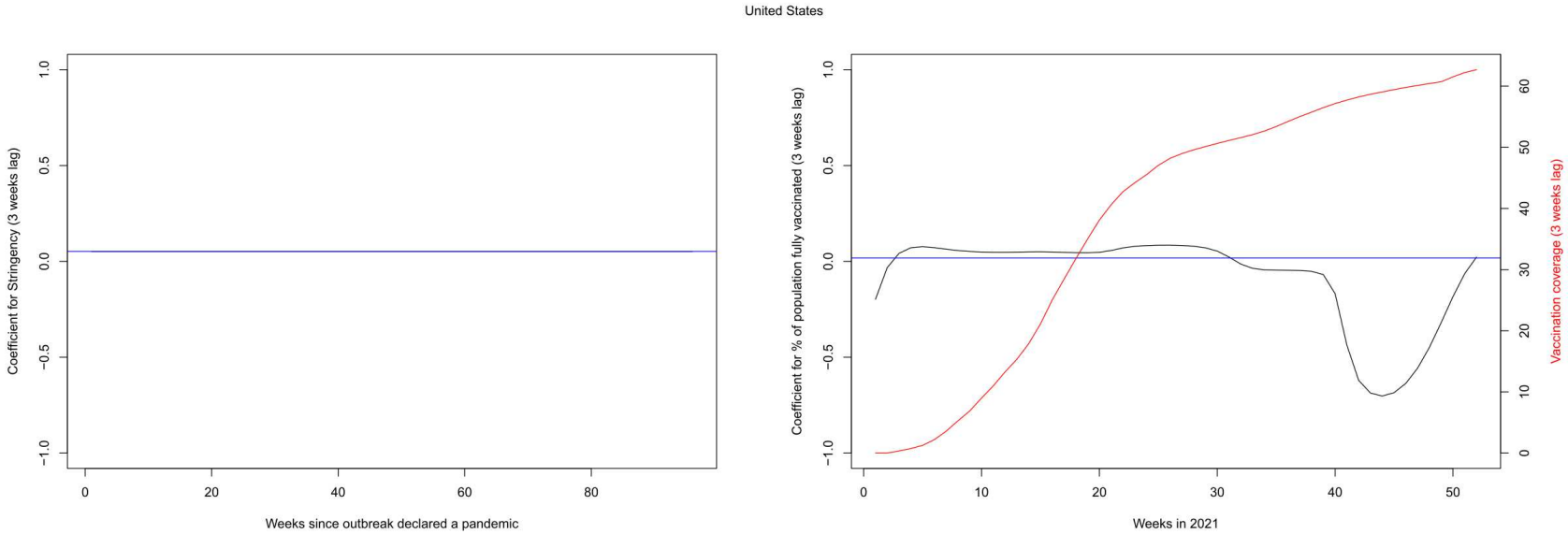

Figure S20 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Australia.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Positive coefficients throughout. NB: black line is superimposed by the blue line.

Vaccination: Coefficients start negative but increase to positive values between weeks 5-30. The coefficients then drop to negative values between weeks 30-50, and then increase again to zero at the end of 2021.

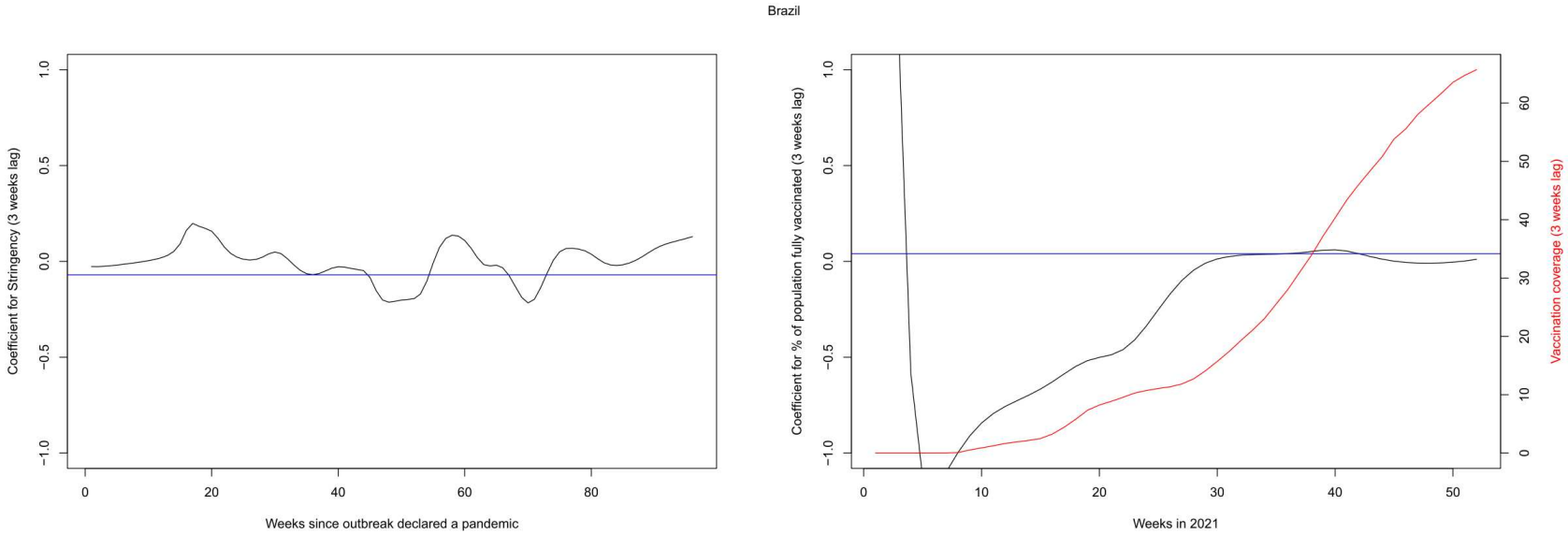

Figure S21 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Brazil.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating between positive and negative values throughout 2020-2021

Vaccination: Coefficients start positive and drop to negative values after vaccine introduction (weeks 5-30), but then increase again to reach a plateau around zero at the end of 2021.

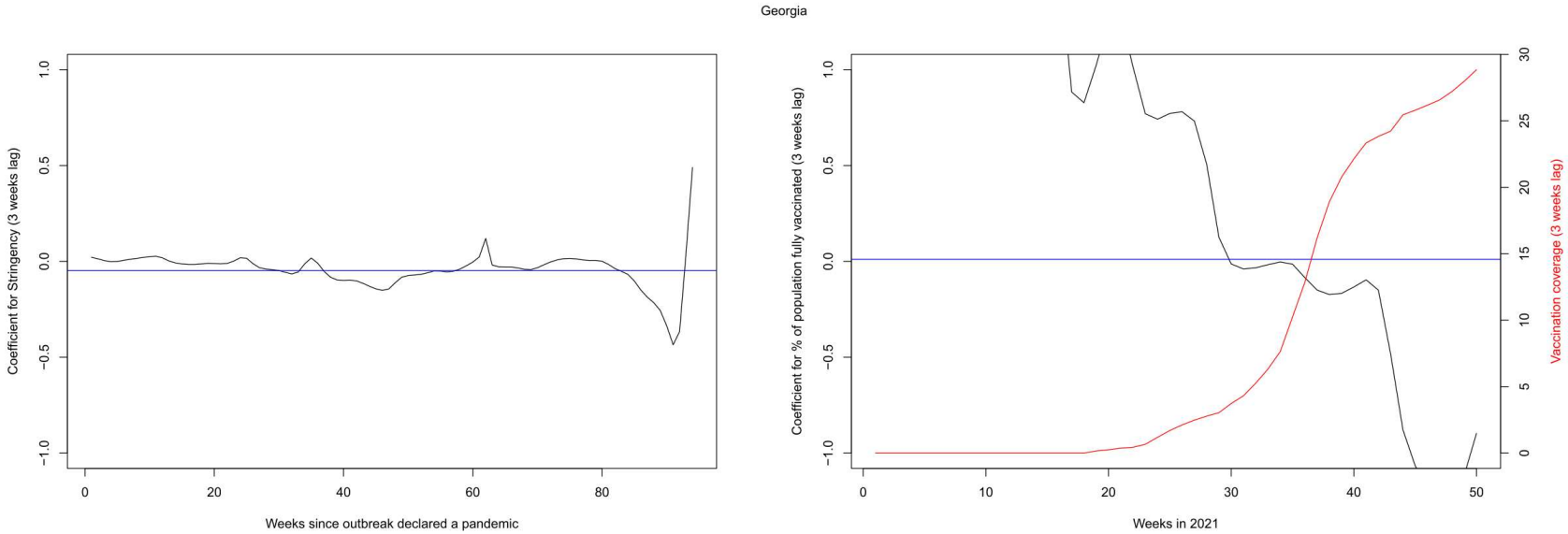

Figure S22 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Georgia.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating between positive and negative values, but were mostly negative in throughout 2020-2021

Vaccination: Coefficients start positive and then drop close to zero around week 30, and remain in the negative range throughout the rest of the year.

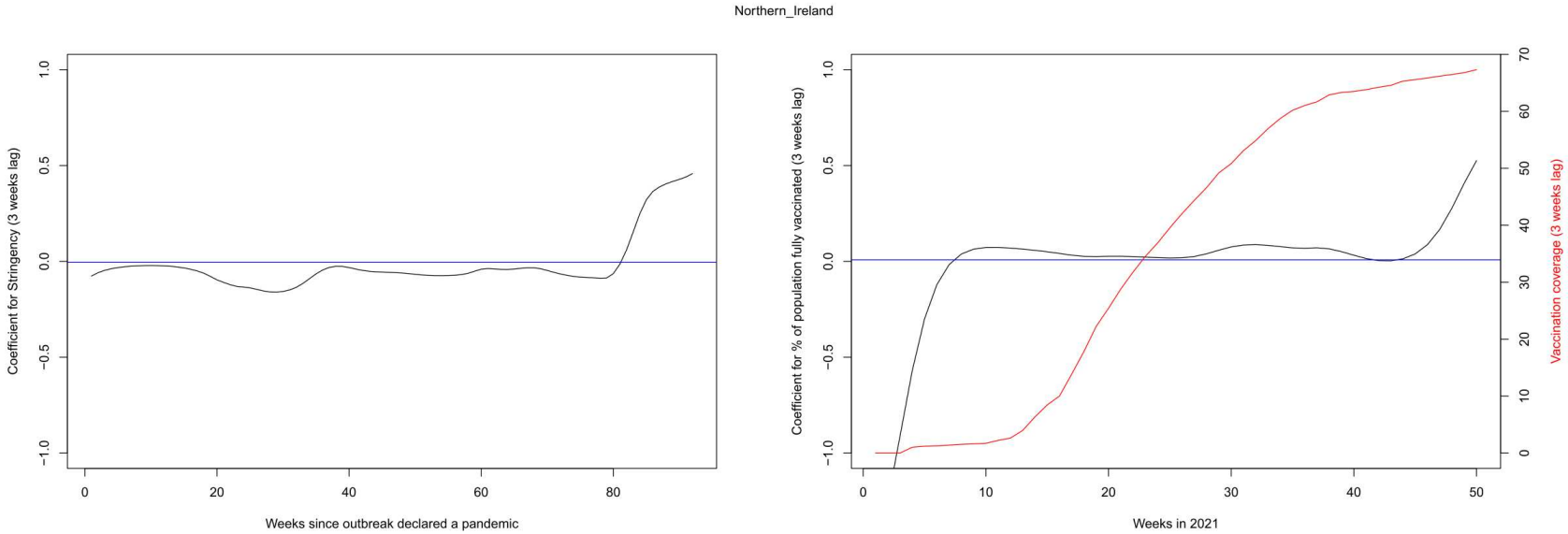

Figure S23 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Northern Ireland.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating throughout 2020-2021, but were in the negative range for most of the years.

Vaccination: Coefficients start in the negative range. Then, coefficients increase towards zero (week 7) where they remain until later in the year. There is one peak during the last 5 weeks of the year.

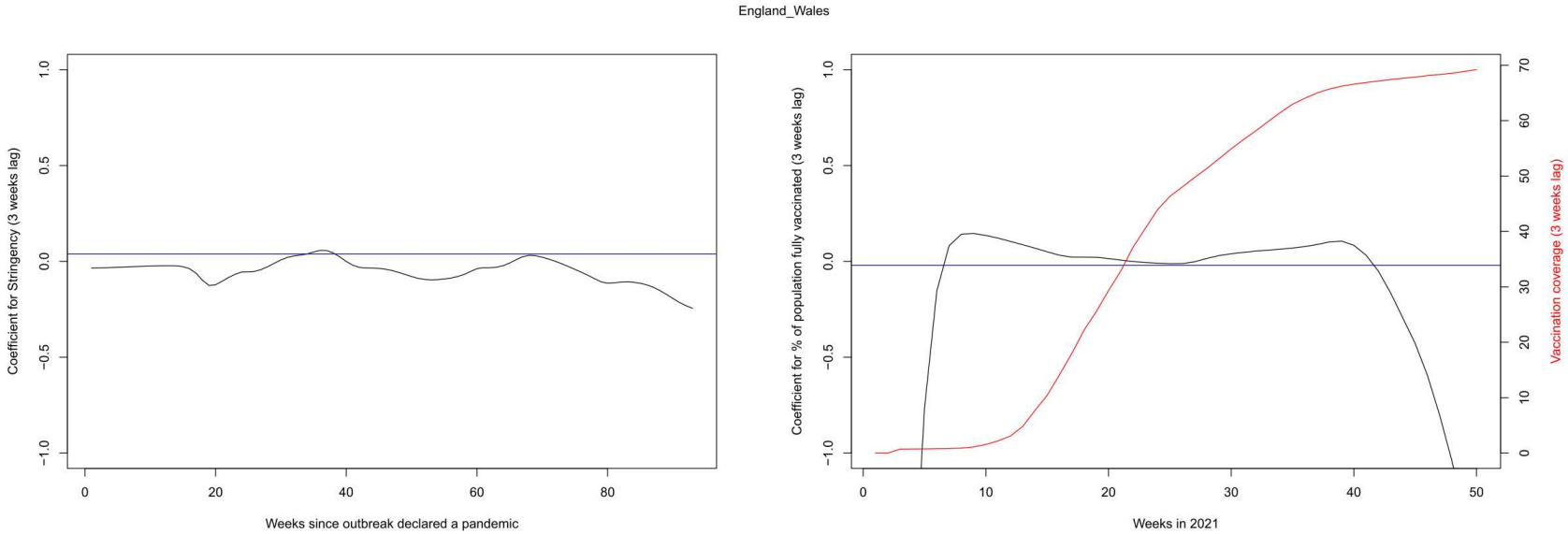

Figure S24 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for England and Wales.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating throughout 2020-2021, but were in the negative range for most of the years.

Vaccination: Coefficients start in the negative range but quickly increase towards zero and weak positive values (week 8) where they remain until later in the year. There is a decrease in coefficients after week 40 of the year.

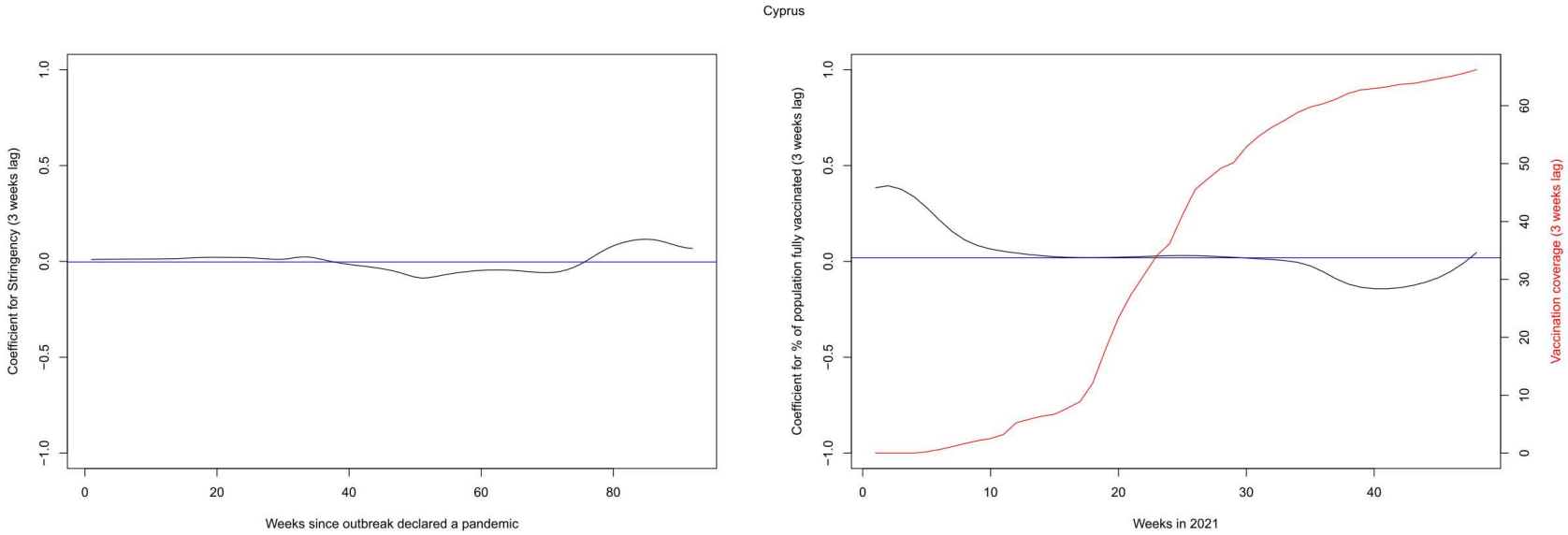

Figure S25 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Cyprus.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating between positive and negative values throughout 2020-2021

Vaccination: Coefficients start positive and then drop close to zero around week 15-30. They then remain in the negative range until the last few weeks of the year when they increase again to values close to zero.

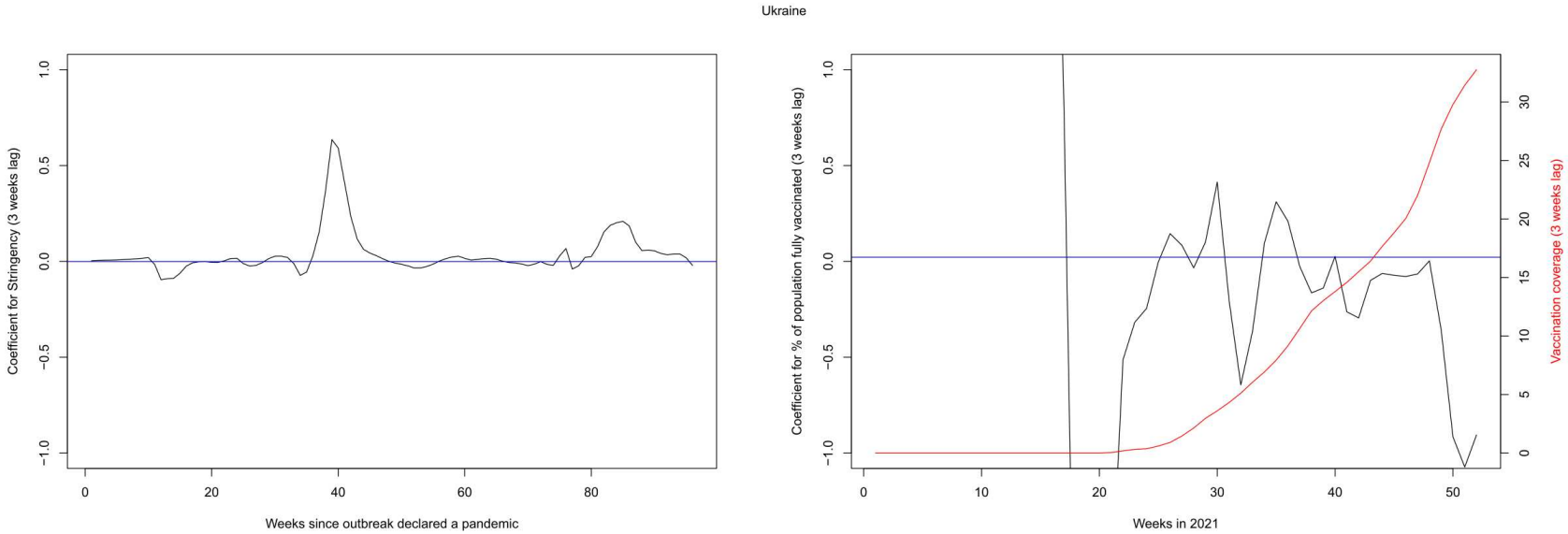

Figure S26 – Time varying coefficients for A) stringency index (3-week lag) and B) % population fully vaccinated (3-week lag) for Ukraine.

Black line marks coefficients obtained from a regression model with time-varying exposure against excess mortality z-scores, adjusting for weekly COVID-19 incidence. The x-axis represents number of weeks, during 2020-2021 for A and during 2021 for B. Blue line represents the coefficient from the corresponding non-time-varying linear regression model. Red line marks vaccination coverage as % of population fully vaccinated in 2021.

Stringency: Coefficients fluctuating between positive and negative values throughout 2020-2021

Vaccination: Coefficients were in the negative range, but increase towards zero wround weej 25 . The coefficients then fluctuate close to zero until the last 5 weeks of the year when they drop to negative values again.

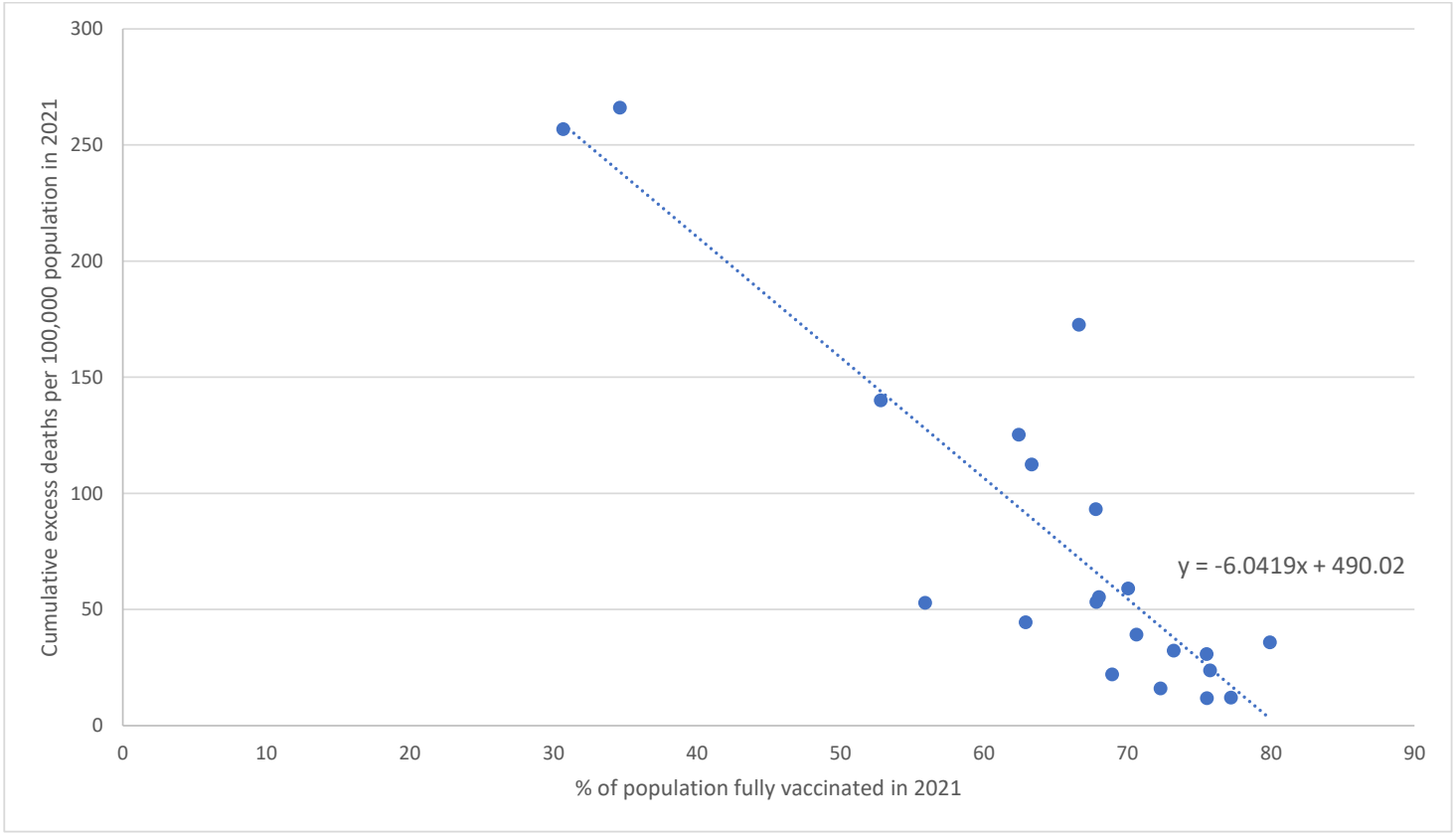

Figure S27. Scatterplot of cumulative excess deaths per 100,000 population and % of population fully vaccinated, across countries, in 2021. Kazakhstan and Peru are excluded due to a completeness of vital registration systems of <90%.