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An analysis of behaviour, health, and GDP during the Covid-19 pandemic in Europe

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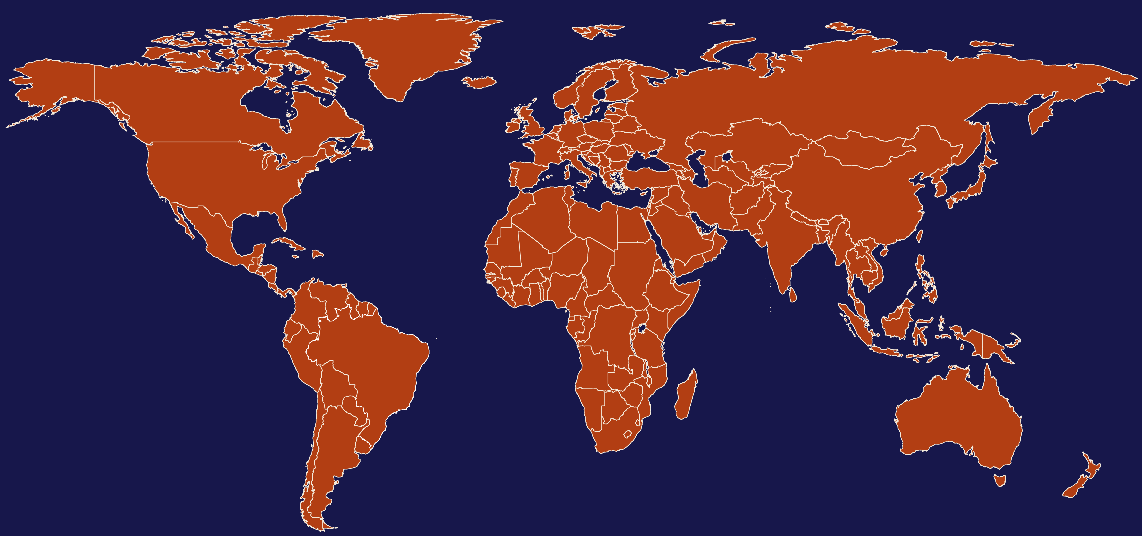

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Foreword

The Graduate School of Public Policy at the University of Tokyo, UTokyo in Japan, received research funds from Hitachi Fund Support for Research Related to Infectious Diseases. The project title has been ”International Joint Study on Public Health Economics and Value Assessment of Prevention in Pandemic -- Lessons learned from Covid-19 and evidence-based recommendations for future crisis”. These funds were distributed between three research groups.

One group consisted of health economists in Asia (Japan, South Korea, and Taiwan). Their task was to analyze diagnostics and tests.

A second group consisted of researchers from the United States, and they were tasked with analyzing vaccines, primarily health economic modeling of vaccines.

A third group consisted of European researchers from Sweden and France who were assigned to study non-pharmaceutical interventions (NPIs) to reduce the spread of the coronavirus and reduce mortality and morbidity related to Covid-19.

Ulf Persson, former professor in health economics at Lund University, now senior advisor at IHE, was responsible for the work of the European group.

This report is a condensed compilation of the work of the European group. The work has generated a number of manuscripts and more are planned for the near future. Some manuscripts are already published including an article in the Swedish Medical Journal (Läkartidningen) by Brådvik et al. entitled ”Swedes stayed at home independent of regulations”.

An earlier version of this report has already been sent to the University of Tokyo and is expected to be included when study results are reported to the Hitachi foundation.

We would like to thank Mårten Augustsson for his contributions to data collection and analysis and Karin Wahlberg for her proofreading during the work with this report.

Lund, February 2025

Peter Lindgren
Managing Director, IHE

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Summary

Following the Covid-19 pandemic in 2020 – 2022, decision makers in Europe imposed non-pharmaceutical interventions (NPIs) to reduce the physical interaction of individuals across the continent. The aim was to reduce the spread of disease; however, the interventions and the behavioral changes also came at a cost, both in terms of quality of life and production losses.

Now when we can look at the pandemic in the rearview mirror, the evidence and knowledge about the effects of Covid-19 are better. This enables us to properly analyse the behavioral changes, the economic costs, and health during the pandemic. Such analyses increase our understanding of the potential trade-offs between benefits and consequences of interventions during future pandemics and better prepare for a future pandemic.

The overall purpose of our research is to use real world data to analyse individuals' behaviour, health and gross domestic product (GDP) during the Covid-19 pandemic in Europe. Our report is based on official data for the European Economic Area (EEA) on an aggregated, macro level during 2020 – 2022.

During the Covid-19 pandemic, we registered an increased excess mortality, a decreased physical interaction, a reduction in health-related quality of life, and GDP-losses. We were however unable to establish a significant negative relationship between NPIs and excess mortality.

Sweden had the lowest excess mortality in the EEA. This may seem remarkable as Sweden for a long period was the country with the least strict NPIs and the smallest reduction in physical interaction of all the EEA countries.

One explanation for this unexpected result might be that NPIs, such as closed borders, travel bans, school closures, and workplace closures, may have been effective under ideal conditions, provided a perfect, or at least a high degree of, compliance. As is shown in our analysis, these ideal conditions did not exist in reality on the population level.

These health and economic costs enlighten the need for pharmaceutical interventions, i.e. vaccines, as an effective intervention to contain a pandemic. A rapid development of vaccines with a high uptake among the population can increase the physical interaction and thereby potentially save substantial production losses and quality of life losses. To justify the costs of imposing extensive NPIs and the following behavioural changes as a public health policy during future pandemic, clear health benefits must be demonstrated as a result of these interventions.

1 Introduction

On 11 March 2020, the World Health Organization (WHO) classified the Covid-19 virus outbreak as a pandemic (1). In the beginning of the pandemic, the situation was very uncertain, and researchers disagreed on its potential consequences. On 19 March 2020, one leading epidemiologist, Stanford professor John Ioannidis, published an article in the European Journal of Clinical Investigation in which he warned that decision-makers may feel compelled to impose severe restrictions without knowing what effect they have (2). He argued that, although we at the time of the pandemic outbreak had been well aware for 150 years of the importance of handwashing, and possibly also the advantage of keeping a distance, our overall knowledge was close to nothing. His message was that it can then be dangerous to hit the drum too hard for things we know nothing about, and which can have other serious consequences.

Three days earlier, on 16 March 2020, Neil Ferguson, another reputable epidemiologist, and his colleagues at the Imperial College Covid-19 Response Team in London had presented a report with model calculations of how the pandemic could develop (3). It received much greater attention. According to Ferguson's estimates, the pandemic could lead to 250,000 deaths in Britain and 1.2 million in the United States if communities were not shut down to completely stop the spread of the disease. The report included detailed mortality estimates for many countries. For example, in Sweden no restrictions would generate 85,000 deaths.

Within two weeks, almost all decision-makers worldwide responded to Covid-19 with a range of non-pharmaceutical interventions (NPIs), hoping to protect their populations by slowing down the transmission of the virus. Most European countries closed borders and adopted strict measures on social distancing, including school and restaurant closures, wearing masks, and sheltering. These measures were inconvenient and had negative effects on economic growth and people's mental health. Sweden's response differed, however, relying largely on voluntary measures and avoiding strict lockdown (4, 5).

The idea of managing a pandemic through reducing physical interaction was first suggested in 1927 by the so called Kermack–McKendrick theory (6). The authors modelled a deadly disease in India during the early 20th century that resulted in a high death rate due to a rapid increasing spread. This caused many people to fall ill simultaneously. The fear of such a scenario was the motivation for imposing NPIs to reduce physical interaction: In order to avoid a situation in which the health care system would be unable to treat the huge amount of people infected by the disease at a quick rate, people were encouraged by the authorities to avoid social contacts and stay at home, as described in a publication by Boumans in 2021 in (7).

Now that we can look at the Covid-19 pandemic in the rearview mirror, the evidence and knowledge about the effects of the pandemic are better than when Niel Fergusson predicted the consequences if no measures were taken. Mortality, morbidity, and health-related quality of life (HRQoL) have been studied. Futhermore, the effects of NPIs have been evaluated.

For example, a meta-analysis, Herby, Jonung, and Hanke (8), used all published studies they could find evaluating the efficacy of NPIs to estimate the outcome on excess mortality in several European countries. Their results indicated that Ferguson's modeling analysis overestimated the mortality consequences of Covid-19 were NPIs not imposed. However, several other published studies, for example Islam et al (2020) (9) and Hsiang et al (2020) (10), indicated that many of the NPIs were effective and should have been implemented to a higher degree in some countries. Many of these studies are based on available data and/or published evidence and considered well-designed as randomized clinical trials (RCT) or before after studies, trying to control confounding factors as good as possible. RCT trials are generally considered providing the highest internal evidence possible.

However, there is also another perspective, the external evidence, referring to evidence demonstrated in the real-world when conditions are not ideal. Individuals may react to their own incentives and real world behaviour is rarely as expected the same as in an RCT. Non-compliance to the implemented NPIs could influence mortality outcomes in unexpected ways.

We may also distinguish between direct consequences of NPIs on mortality and morbidity and indirect consequences. Direct consequences are the effect of the preventive efforts per se, e.g. reductions in the spread of the viruses by using face masks, regulated traveling activities, and reduced physical interactions between people. Indirect consequences appear as individuals' behavior change. Behavioural changes have an impact on economic activities independent of whether they are caused by NPIs or by individuals' own choice. It is important to understand how behavioural changes influenced the economic activity, production of goods and services during Covid-19. Behavioural changes also influence households' and individuals' purchases of goods and services that are aimed to improve health and safety. Reduced income to households will therefore also have a substitutional effect that may reduce investment in health and increase risk of mortality and morbidity. It is a well-established fact that income is positively correlated with health. Since income loss is strongly related to preventive activities undertaken by households and public or private health care providers, we can expect that income loss will also have an impact on people's health, i.e. an indirect effect.

The behavioural changes following implementation of NPIs during Covid-19 came at a cost, both in terms of quality of life and production losses. What was the degree of the health and economic consequences of Covid-19 in European countries? The answer to this question would require estimations of the health care cost, production loss, costs of NPIs (e.g. social distancing), impact on QoL, and mortality, including health loss due to crowding out in health care.

1.1 Purpose

The overall purpose of our research is to use real world data from the Covid-19 pandemic to clarify how costs of infection control could be minimised in a future pandemic. Such costs include both health loss, QoL, and economic costs related to the burden of NPIs.

We aim to increase the understanding of how different levels of restrictions that affect peoples mobility and activities, as well as advice and recommendation, impact the behaviour of individuals. Furthermore, we aim to understand the health related burden and economic effects of the imposed NPIs.

The report is based on data regarding the behaviour of individuals in the European Economic Area (EEA) on an aggregated, macro level during 2020 - 2022. We study their physical interaction by using mobility data and the effects on labour and production captured by changes in gross domestic product (GDP). Given the macro perspective of our analysis, causal relationships are not to be established. Nevertheless, it serves as an extensive analysis of the consequences of the different political approaches to handle the Covid-19 pandemic in the EEA which we hope can provide guidance for decision makers during future pandemics.

1.2 Framework for the analysis

The positive association between socio-economic status and health is a well-established empirical fact (11). Many studies, especially from sociology or public health, use social class or education as the measure of socio-economic status, whereas economists tend to focus more on income. At the aggregate level, the positive correlation between income and health is very robust. This is known as the Preston curve (12) which compares countries and shows a clear link between capita GDP, a measure of average income in a given country, and population mortality, usually represented by life expectancy at birth. The link is particularly steep within developing countries, and tend to be more flat for richer countries. At the individual level, the positive correlation between income and health is also a very robust empirical finding, which holds for mortality as well as for most diseases (13). The Pretson curve is illustrated in Figure 1.

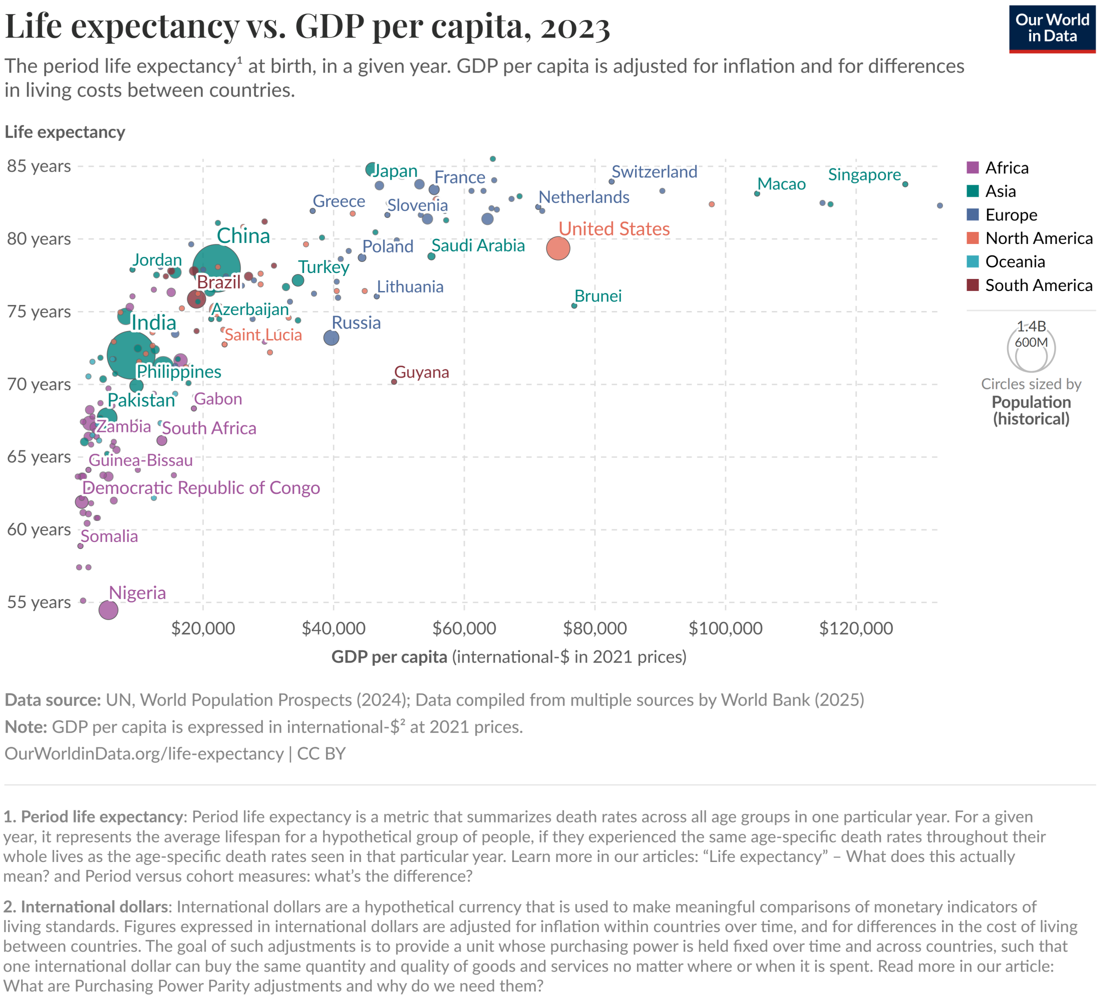

Figure 1. The Preston curve in 2023

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However, this positive correlation cannot be immediately interpreted as a causal relationship, especially at the aggregate level. High income countries spend more in health care, have more health care professionals per capita, have more and better hospitals and health care facilities, and can afford recent developments at the frontier of medical technology, i.e. innovative, effective cancer medicines, or gene therapies (15). In contrast, scarcity of resources in developing countries and in particular in the least advanced economies puts a heavy burden on health care systems, which often fail to provide basic care to the sick, lack hospital beds and staff, not to mention recent effective but expensive treatments. Richer countries also spend more in preventive measures such as water and food safety, road safety (16, 17), or investments that reduce industrial pollution, which are good for population health.

However, two elements should be noted. Firstly, individuals in richer countries also enjoy overall higher education levels than in poor countries; and since education is positively associated with both income and health, the observed correlation between income and health may simply reflect this common cause. Besides, better health is also associated with higher productivity at work, higher employment rate (especially at older ages), which both increase income; this reverse causality may also explain a substantial share of the observed correlation between income and health.

Secondly, the empirical analysis of economic booms and busts leads to a less clear picture. A famous paper by Ruhm in 2000 (18) found that recessions improve health, and the author interpreted this finding by the fact that people may be more likely to exercise, less likely to smoke and drink or engage in risky activities as car driving. But other authors, auch as Stuckler et al (19), disputed these results and interpretations, and a subsequent paper by Ruhm himself in 2015 noted that the positive effect of recessions on health is not found on more recent data (20). Indeed, what happens during a recession may vary a lot across countries. The drop in public revenues during a recession may lead some countries to cut health care budgets, with a direct effect on population health (21), but some countries may opt for a preservation of health care services, accepting public deficits and an increase in public debt.

The Covid-19 pandemic is different in nature from the economic recessions usually studied. Before leading to a sharp decrease in economic activity, it was a health crisis, and hospitals were in great difficulty to cope with the sudden and unexpected increase in the number of patients in need of care. Governments apparently faced a difficult trade-off: should population mobility be reduced in order to prevent hospital overflow, at the cost of a drop in economic activity? Or should economic activity be preserved, at the cost of an increase in the infection rate, more cases, and more hospital congestion?

In other words, the proposed measures of NPIs as interventions during the Covid-19 pandemic were expected to induce an income reduction for an expected benefit in health, i.e. trade-off between income and health, as illustrated in Figure 2. Our research tries to enlighten this relationship between income and health during the Covid-19 pandemic in Europe.

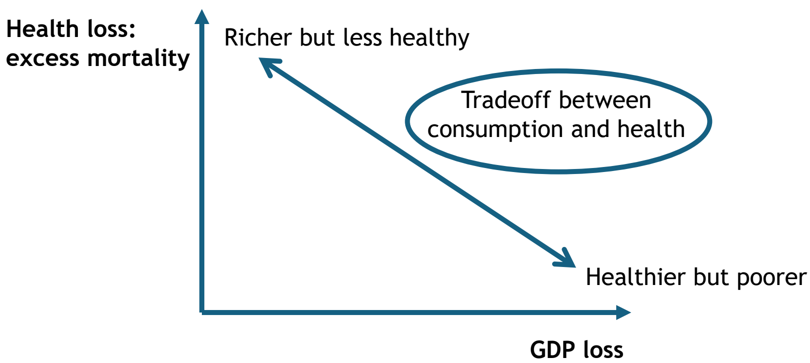


Figure 2. Conceptual framework tradeoff health and production

Implementing the NPIs in European society was never expected to produce a positive income effect. NPIs were expected to have a negative economic impact. However, NPIs are only one among several factors that can affect individuals' behaviour and result in negative income effects. Individuals also make their own decisions to protect themselves from viruses which affect the risk of morbidity and mortality. An analysis of the relationship between safety measures included by the NPIs, income, and overall mortality will require understanding of how individuals respond to NPIs and information about risk of infection related to other interventions such as vaccinations. Thus, an analysis of income and mortality must also consider the individuals' behaviour.

Our analysis is based on the aggregated behaviour of individuals and its link with health and labour activities (Figure 3). Health is divided into two types: The first is health related to individuals becoming sick and their loss of health due to morbidity and mortality. The second type of health is the impact of health-related QoL for individuals in the general population, exposed to the risk of getting sick and/or experience negative economic effects of the pandemic. The QoL related health changes can either be imposed by public restrictions on behaviour or by individuals' own perception of risk and their subsequent decisions to change behavior to prevent themselves and relatives from getting infected. Labour activities are also divided in two components, production and income.

The value of production can be estimated using market prices of services and goods produced. Income (labour income) is a fraction of the value of production that belongs to the individual and is therefore also a factor that may influence his or her behaviour.

Similarly, infection risk will also be considered both as a factor that can influence individuals' behaviour by causing fear for sickness and as one that be influenced by individuals' risk taking.

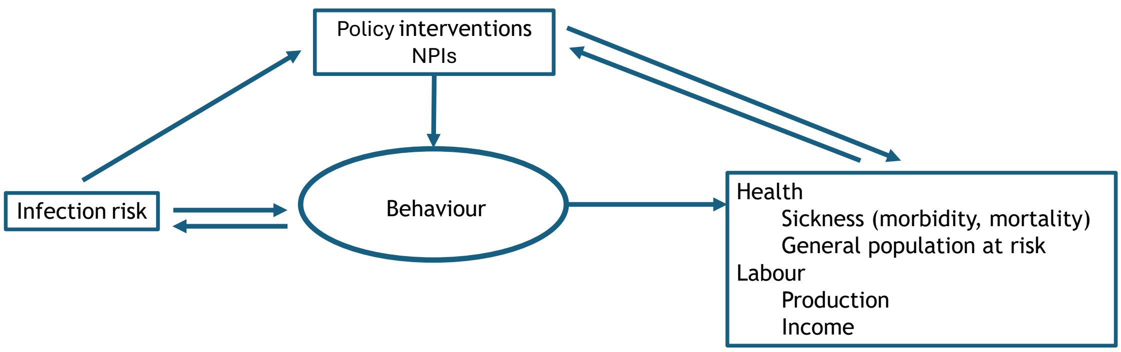


Figure 3. Conceptual framework early policy responses

Furthermore, public policy interventions, e.g. NPIs, are another factor that influences individuals' behaviour. It has been observed that policy interventions were stricter in the beginning of the pandemic when there was no vaccine available. However, later on when vaccines were accessible and their uptake reached a significant level, we hypothesize that this reduction of the infection risk also had a direct impact on individuals' behaviour.

In our analysis, we use a number of surrogate variables to demonstrate changes in the variables we are interested in. For behavior, we use mobility data from Google (22). For infection risk we use excess mortality. As a measure of NPIs, we use the Oxford Stringency Index (23). We consider the share of the adult population fully vaccinated (people who received at least two doses) (23). Labour activity is estimated by GDP (24).

Health loss is estimated by two measures:

1. Excess mortality during the pandemic.

2. Quality adjusted life years lost (QALY) due to excess mortality and in the general population.

The excess mortality is available monthly on country level (25). For the QALYs lost, we only have access to estimations from two EEA countries, Norway and Sweden, and the data are only available for two months (26).

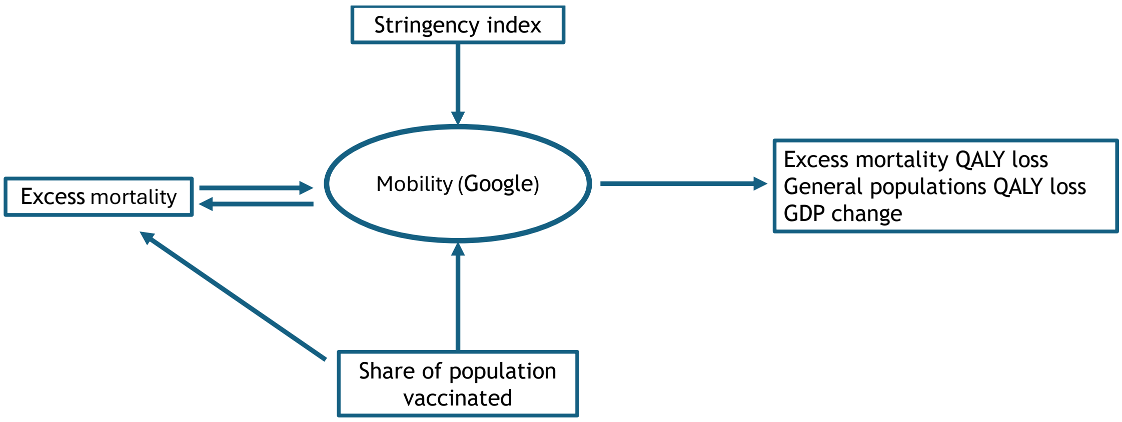
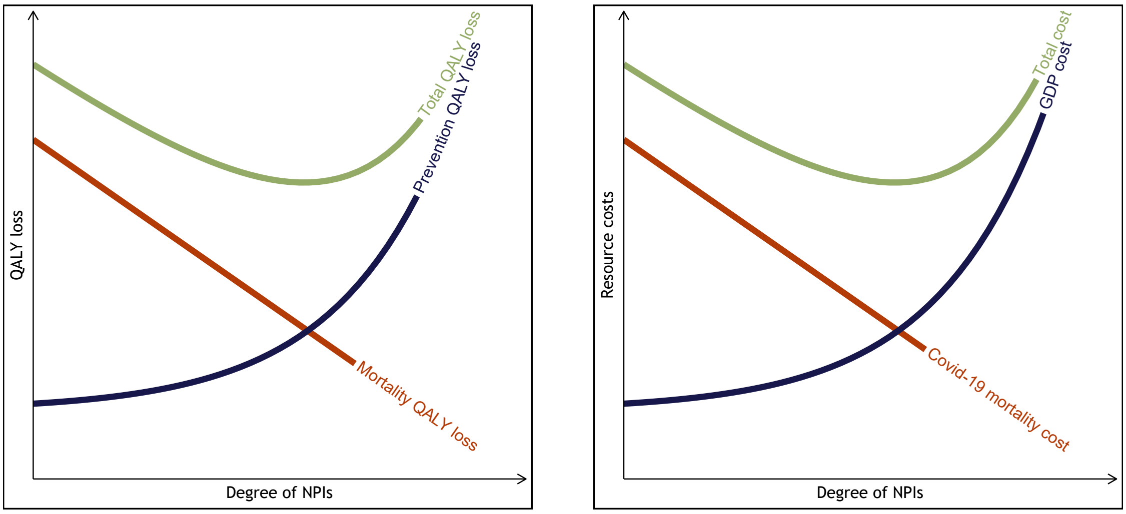


Figure 4. Conceptual framework of our measures

In Figure 4, we describe our analysis model. Our analysis has been trying to find two relationships: The first one is between NPIs and QALY loss due to excess mortality. The second one is between NPIs and the general population's QALY loss related to changes in behaviour. These behavioural changes are expected to be explainable by individuals' perceived risk and income loss. The hypothesis is that an understanding of this relationship will provide us with information regarding the tradeoff between these two health variables and enable us to estimate a tradeoff between prevention of mortality and QALY loss related to restrictions, i.e. NPIs, see (a) in Figure 5.

An additional aim of the analysis is to better understand the value of preventing mortality and the costs for implementing measures related to preventive measures such as NPIs. Our hypothesis is that such understanding could guide the decision on which degree of restrictions that should be used to minimise both the costs of both NPIs and excess mortality. This is shown in (b) in Figure 5.

In this report, we intend to try to establish and measure both these relationships mentioned above.



(a) Tradeoff health

(b) Tradeoff resource cost

Figure 5. Theoretical tradeoffs between NPIs and costs in terms of QALY and resource cost

1.3 Included countries and time period

Our European analyses cover the countries in the EEA since there are consistent data available for these countries from the European Statistical Office (Eurostat). The EEA includes the following countries:

- Austria
- Belgium
- Bulgaria
- Croatia
- Cyprus
- Czechzia
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Iceland
- Ireland
- Italy
- Latvia
- Liechten-stein
- Lithuania
- Luxem-bourg
- Malta
- Nether-lands
- Norway
- Poland
- Portugal
- Romania
- Slovakia
- Slovenia
- Spain
- Sweden

Cyprus, Iceland, and Lichtenstein have been excluded due to lack of data over physical interaction. The analysis is conducted for three years, during 2020 - 2022. The exact start and end dates during these years for each of the analysis are specified in their respective chapters.

2 Mortality

The aim of this chapter of the report is to investigate the mortality during Covid-19 in the EEA countries. The fear of an increased mortality during Covid-19 as a consequence of the virus was one of the motivations behind the NPIs with the aim to reduce physical interaction following the outbreak of the pandemic in early 2020 (7). We describe the excess mortality in the studied EEA countries and its correlation with the NPIs and the GDP loss.

2.1 Material and method

We use the following variables aggregated on national level in the analysis:

- **Excess mortality (%).** We use the monthly excess mortality compared to the period 2015 - 2019 to study the Covid-19 mortality (25). It can also be seen as a proxy variable for the impact and spread of the disease since there is no reliable data on the exact number of infected people. The excess mortality was also strongly correlated with the hospitalisations due to Covid-19 (27).

- **Adults fully vaccinated (%).** The percent of adults who had received at least two doses of vaccine according to (23).

For excess mortality, we also investigated potential correlations with the correlation between excess mortality and the Stringency Index and the GDP gap. The first variable is a measurement from 0 to 100 of the degree of NPIs imposed in each country during the pandemic, see section 3 *Behaviour and NPIs* for a further definition. The GDP gap is the economic GDP loss caused by the pandemic, see section 6 *GDP* for its formal definition.

The analysis stretches from 1 January 2020 to 31 December 2022. Figure 13 and Figure 14 cover only February 2020 - September 2022 due to the limited availability of behavioural data used in the economic analysis in section 6 *GDP*. The behavioural data are not available before February 2020 and are only available for a limited part of the fourth quarter of 2022. The GDP data from Eurostat are quarterly and the economic analysis in this report is therefore cut off in the fourth quarter of 2022 (see section 6 *GDP*).

2.2 Results

Excess mortality was notable in all the EEA countries during the period 2020 - 2022, as is shown in Figure 6. There were however substantial differences between the countries. The Nordic countries, Sweden, Norway, Denmark, and Finland had a much lower excess mortality during the study period than Eastern European countries such as Bulgaria, Poland, Slovakia, Czechia, and Romania. Sweden, the country with the lowest excess mortality during the study period, had an excess mortality of 13 percent. The corresponding figure for Bulgaria, the country with the highest excess mortality, was 61 percent.

There were also differences between the years. Sweden stood out with a low excess mortality compared with the other EEA countries in 2021 and 2022, but not in 2020. Norway, the country with the second-lowest excess mortality, did not have any excess mortality at all during 2020. Norway surpassed Sweden in 2022 when the country suffered a relatively high excess mortality compared to other countries during that year.

The countries with the highest total excess mortality, such as Bulgaria, Poland, Slovakia, Czechia, and Romania, had much of the excess mortality during 2021.

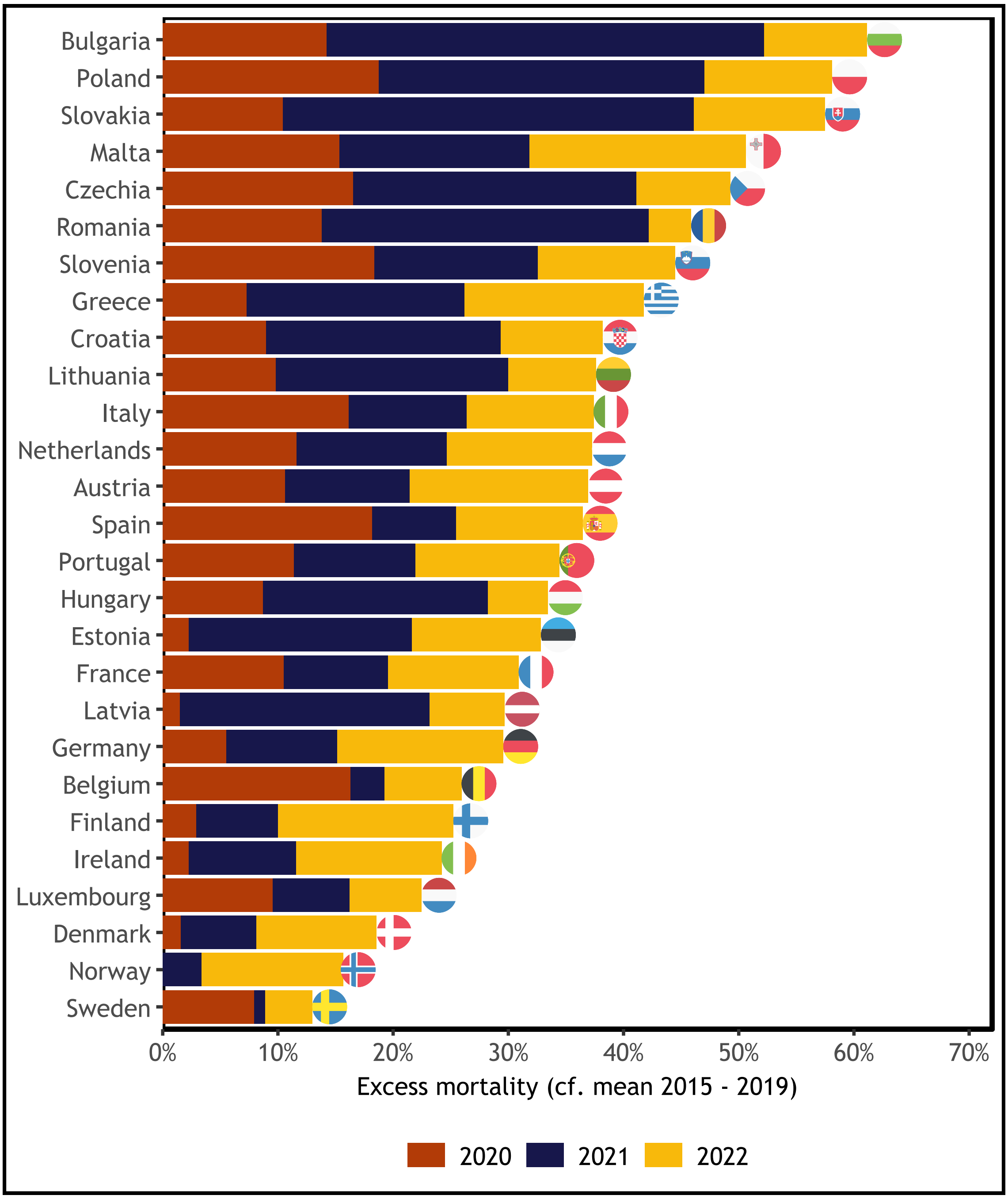


Figure 6. Excess mortality 2020 - 2022 in the EEA countries

Source: Calculations based on (25).
Note: The flags are to the right of the excess mortality values. Norway had a negative excess mortality in 2020, -0.2 percent, which is not illustrated in the Figure. The total excess mortality in Norway for 2020 - 2022 was 15.5 percent, whereas it is 15.7 percent in the figure. This does however not affect the ranking between Norway and the other countries.

In this report, we highlight the four Nordic countries, which had a relatively low excess mortality, five Eastern European countries with the highest excess mortality[1], and the four largest EEA countries in terms of population and total GDP: Germany, France, Italy, and Spain. The highlighted countries are shown in Figure 7.

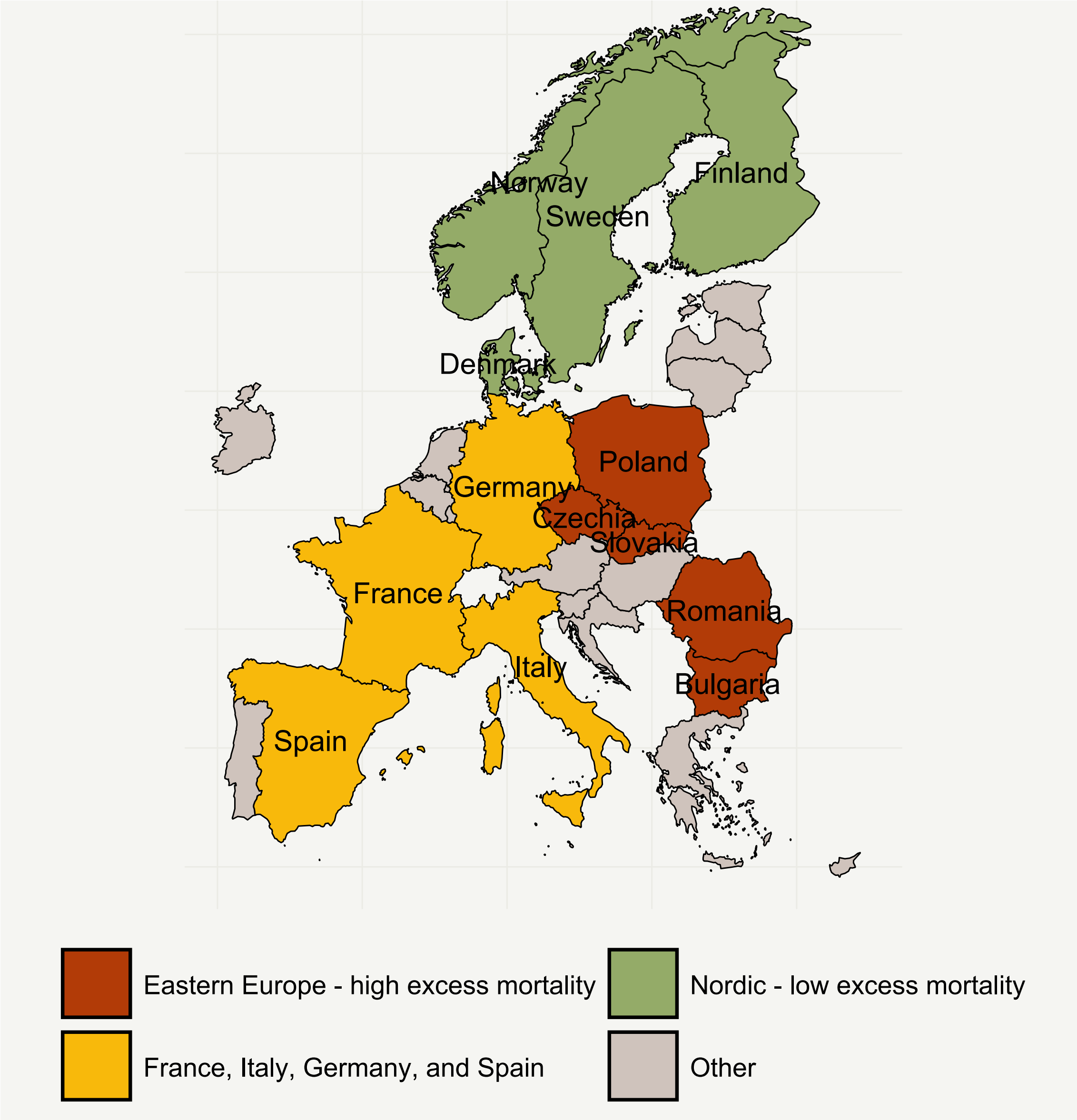


Figure 7. EEA countries closer investigated

The excess mortality over time in the four largest EEA countries is shown in Figure 8. In particular Spain and Italy, but also to some extent France, were badly hit by a high excess mortality in March and April 2020. Germany eluded this first covid wave and was severely hit first in late 2020 and early 2021. Generally, Germany and France had a smaller fluctuation in the excess mortality compared to Italy and Spain.

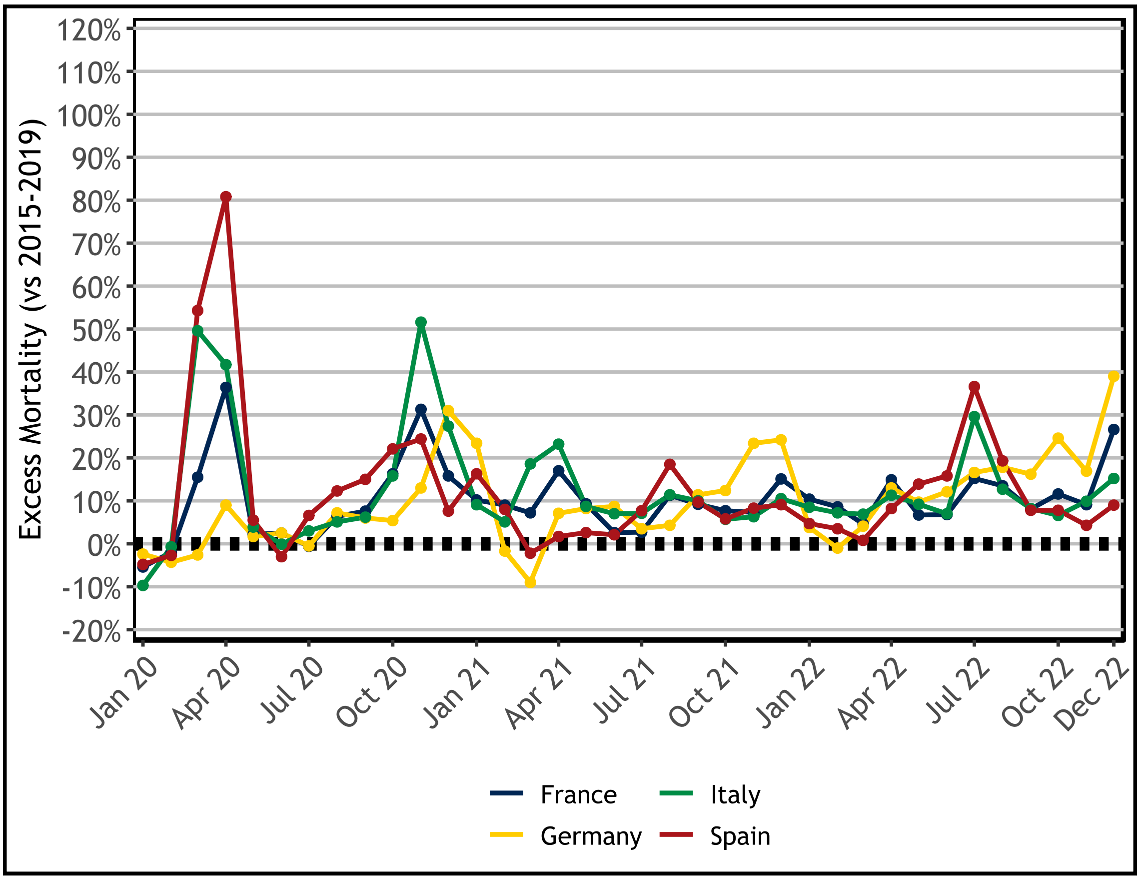


Figure 8. Excess mortality 2020 - 2022 in the four EEA countries with the largest population

Source: Calculations based on (25).

In the countries with the highest excess mortality, a substantial proportion of the excess mortality during 2021 occurred in March and April (Figure 9). It was not until the second half of 2021 that vaccinations had reached a substantial share of the population in the EEA (see Figure 12 on page 20). These countries did however also suffer from a high excess mortality in late 2021.

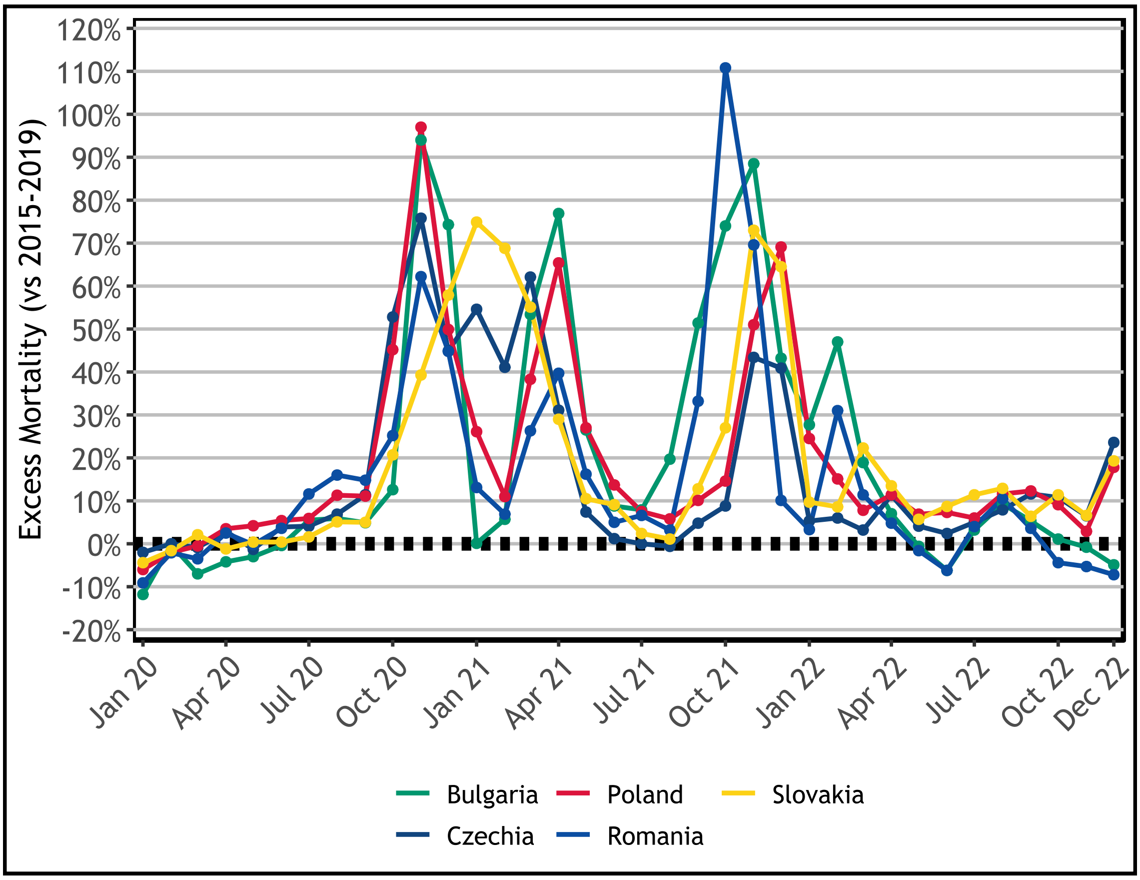


Figure 9. Excess mortality 2020 - 2022 in the highlighted countries with the highest excess mortality

Source: Calculations based on (25).

Figure 9 shows that the five countries with the highest excess mortality follow a similar pattern regarding when the excess mortality occurred. It was not until late 2020 that the countries were hit by the pandemic to a greater extent. Thereafter, it was particularly during the winter and spring seasons that they suffered from a high excess mortality.

Excess mortality in the Nordic countries also varied over time and between the countries, as can be seen in Figure 10. Sweden demonstrates a relatively high excess mortality during the first wave of Covid-19 in spring 2020 as well as during the second wave at the end of 2020 and beginning of 2021. However, for most of the subsequent period, Sweden had a very low or no excess mortality (with some exceptions, like in December 2022). The first wave of excess mortality occurred mainly in the Stockholm area, while there was mostly limited excess mortality outside this capital area in spring 2020 (28). Parts of Eastern Sweden including Stockholm had a school vacation in the last week of February and many people travelled to northern Italy for skiing (29). This was the same period when Covid-19 demonstrated its first wave in Europe, not the least in Italy (as was shown in Figure 8).

Denmark, Finland, and Norway had very low excess mortality during the first wave and there was only a small excess mortality during the second wave during the end of 2020 and the beginning of 2021 in Denmark and Finland. The excess mortality in Denmark, Finland, and Norway was concentrated to 2021 and 2022.

The low excess mortality during the later period in Sweden may be explained by a subsequent mortality deficit. During July and October 2020, the observed mortality in Sweden was even lower compared to the average during the same months in 2015-2019. This is according to expectations as the excess mortality mainly occurred among older individuals with a high level of comorbidity who would have died later due to other reasons even if not infected by Covid-19. For the same reason, excess mortality during a seasonal flu is usually followed by a period of an excess mortality deficit.

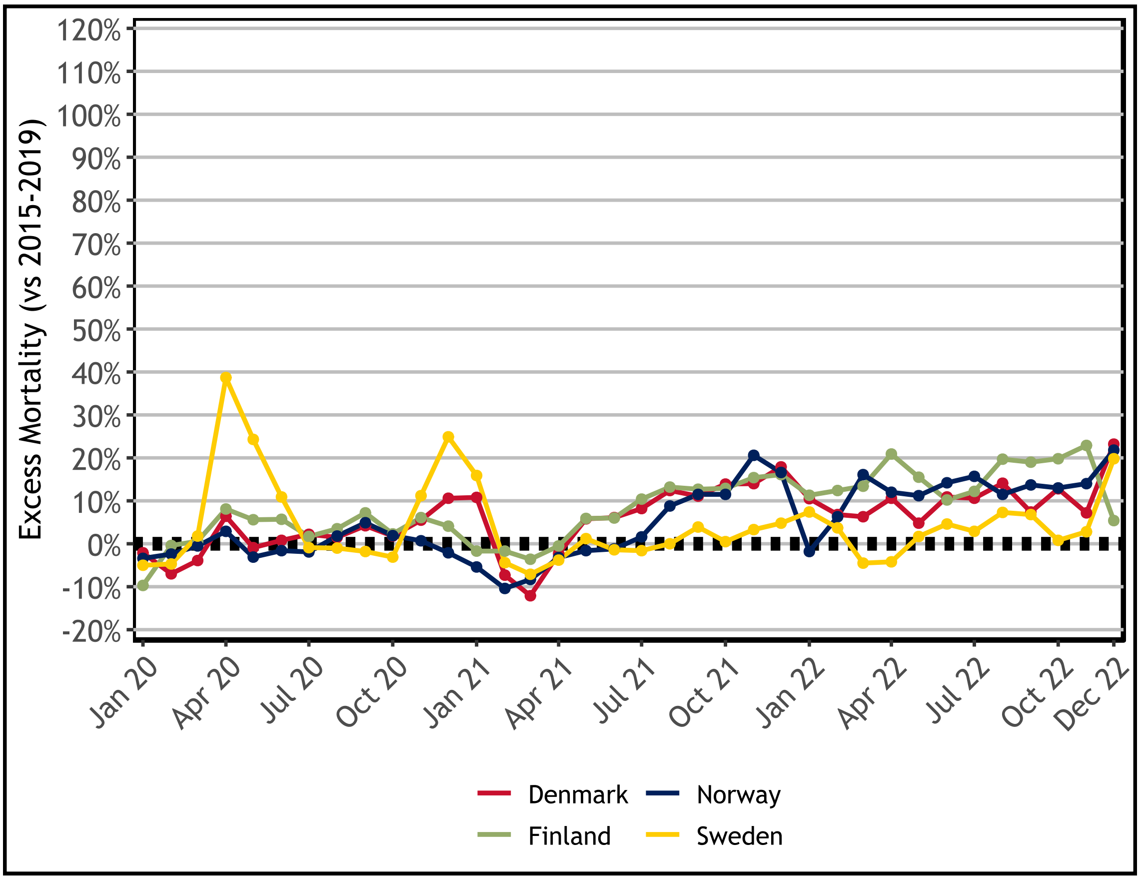


Figure 10. Excess mortality 2020 - 2022 in the Nordic countries

Source: Calculations based on (25).

In Figure 11, the differences in excess mortality over time and between the groups of countries are illustrated. The first wave of Covid-19 pandemic provided an excess mortality in the four largest EEA countries as well as in the Nordic countries (as has been mentioned, mainly in the Stockholm region in Sweden). The second wave during the winter 2020 and spring 2021 resulted in an elevated excess mortality in all three country groups. The countries with high excess mortality in Eastern Europe were hit by the excess mortality during the pandemic later than the other highlighted countries. They experienced their first wave of excess mortality in the winter of 2020 and spring of 2021.

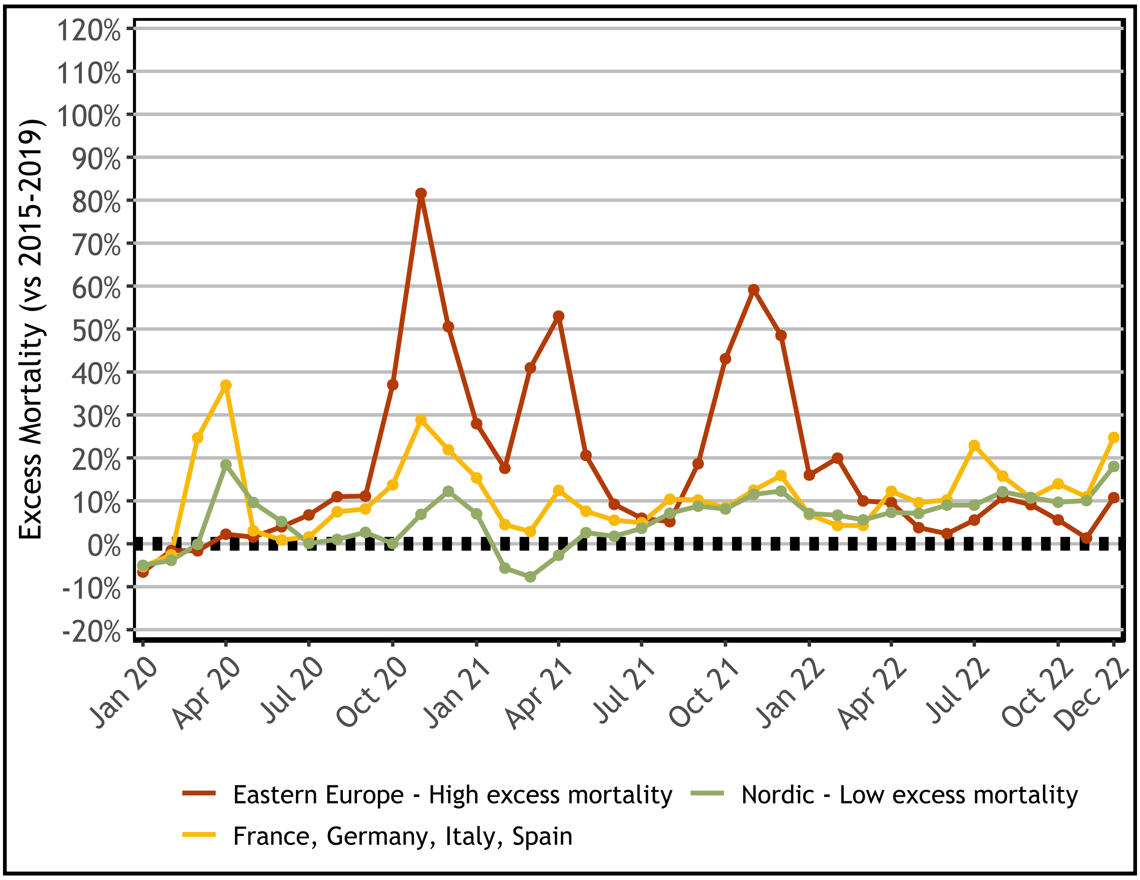


Figure 11. Excess mortality 2020 - 2022 in the investigated groups

Source: Calculations based on (25).

Note: The average values for the groups are weighted by the population in the countries within the groups.

Pharmaceutical interventions (PIs), i.e. vaccinations, were introduced to reduce infection risk and the negative health consequences of infection by Covid-19, including mortality. The uptake among the adult population is shown in Figure 12 by the country groups. Vaccinations started in the EEA in late December 2020, and by August 2021, the majority of the adults had been fully vaccinated. There were however substantial differences in vaccination rate between the different country groups, despite the vaccine being equally distributed among the countries by the EU (30).

In a literature review from 2022 by Popa et al (31), it is concluded that: "The main Eastern European determinants of Covid-19 vaccine acceptance identified from the included studies are: public confidence in the vaccines' safety and efficacy, vaccine literacy, and public trust in the government and the medical system." (p 1).

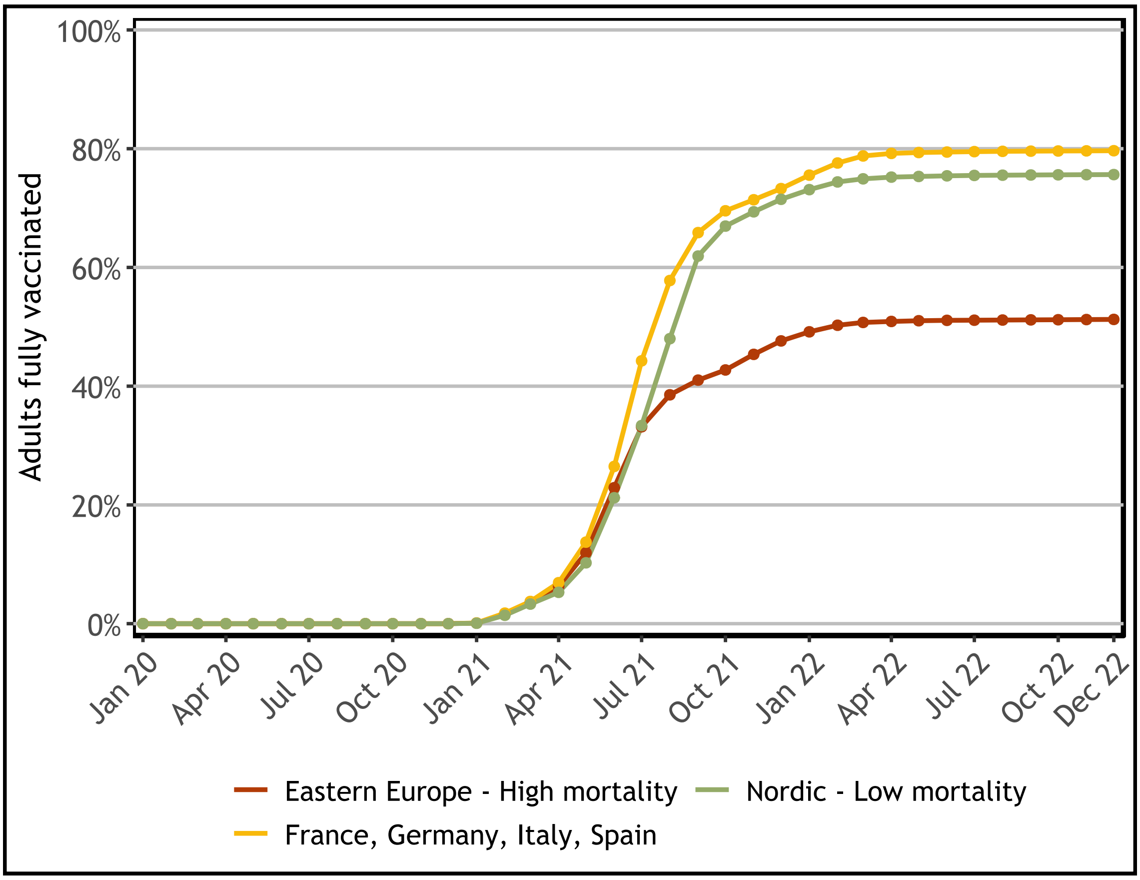


Figure 12. Adults fully vaccinated (at least two doses) in the investigated groups

Source: Calculations based on (23, 25).

Note: The average values for the groups are weighted by the population in the countries within the groups.

During the first year of the pandemic, 2020, we could not find a tradeoff between NPIs (Stringency Index, which is described in section 3 *Behaviour and NPIs*) and excess mortality, as can be seen in Figure 13 (a). The only relationship to be found is the opposite one; the countries that implemented stricter regulations also tended to have a higher excess mortality. For the second year of the pandemic, 2021, there is no correlation at all between the variables, Figure 13 (b). During 2021, all of the highlighted Eastern European countries with a high mortality (red) had a higher excess mortality than the other EEA countries. In the third year of the pandemic, 2022, all countries had reduced their restrictions, Figure 13 (c). The excess mortality was also at a lower level than the previous years in most of the countries. Still, the weak, but nevertheless positive correlation between a higher stringency and a higher excess mortality that was to be observed in 2020 remained in 2022.

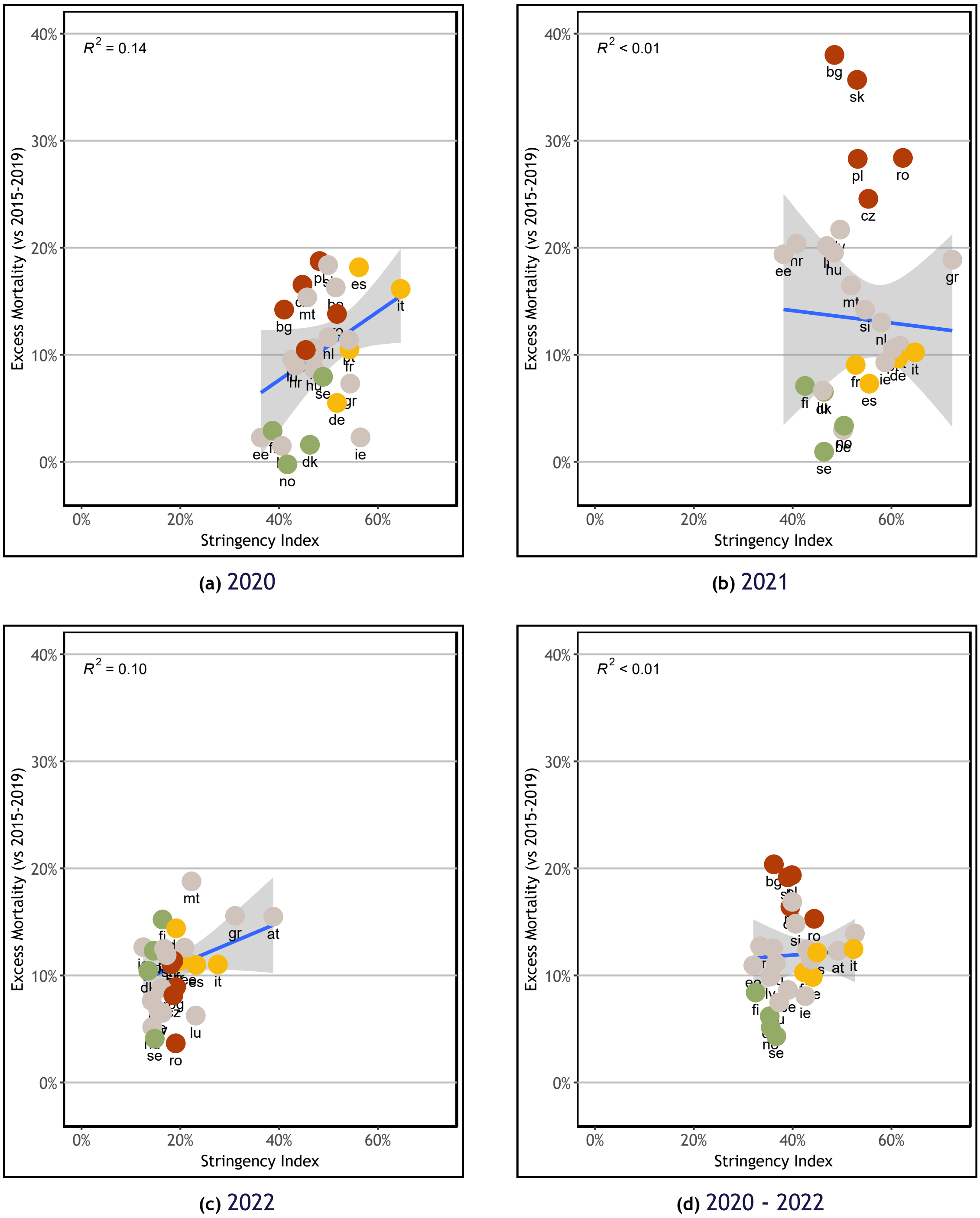
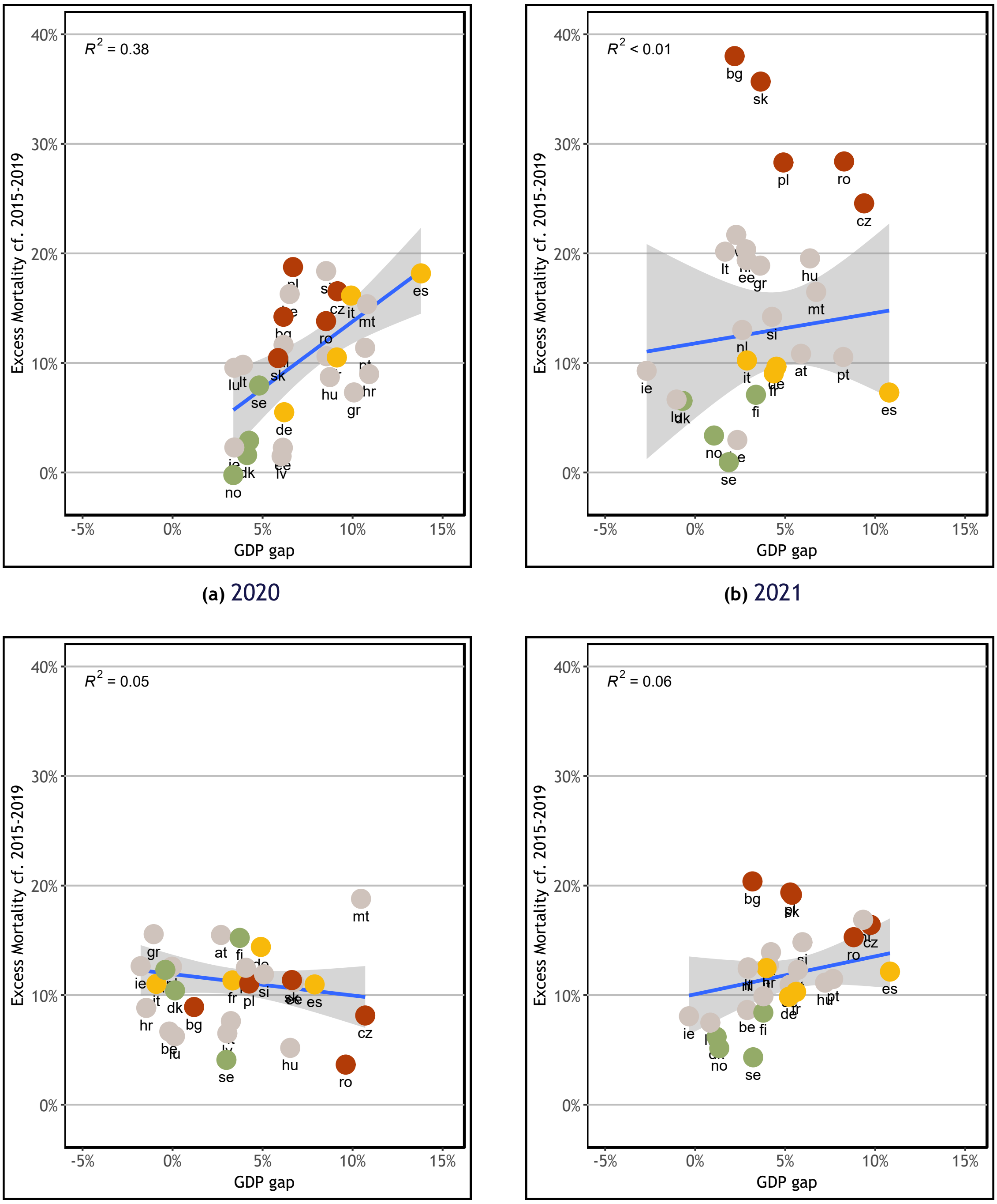


Figure 13. Correlation between excess mortality and Stringency Index

Source: Calculations based on (25, 23).

Note: The regressions are weighted by the population in the studied countries.



(a) 2020 (b) 2021 (c) 2022 (d) 2020 - 2022

Figure 14. Correlation between excess mortality and GDP gap

Source: Calculations based on (25, 24).

Note: The regressions are weighted by the GDP in the studied countries.

As for the correlation between GDP and excess mortality, we see in Figure 14 (a) that the GDP gap, that is the estimated GDP loss, was generally higher in 2020 in the countries with a higher mortality. In 2021, Figure 14 (b) and 2022, Figure 14 (c), this correlation between the GDP gap and excess mortality is not to be found. However, among the Eastern European countries with the high excess mortality, we note the excess mortality in 2021 is higher for countries with a smaller GDP gap.

2.3 Discussion

The mortality during Covid-19 clearly came in different waves. These affected the countries and country groups differently. For instance, the highlighted Eastern European countries did not experience the first wave that hit Sweden, Spain, Italy, and France. However, eluding the first infection wave in spring 2020 did not result in a lower overall excess mortality. Sweden, that was hit by the first wave, had the lowest excess mortality among the EEA countries in the period 2020 - 2022, whereas Bulgaria, that did not suffer from any excess mortality until mid-2020, had the highest overall excess mortality.

There was no negative relationship between the level of NPIs and excess mortality. Instead, a weak positive correlation could be found between excess mortality and NPIs in 2020 and 2022. Thus, a higher mortality seems to have led to a higher degree of NPIs.

Notably, the highlighted Eastern European countries with a high excess mortality overall had a considerably lower vaccination rate than the other country groups after July 2021. Whereas a negative relationship between NPIs and excess mortality could not be established, there seems to be one between PIs and excess mortality.

These findings are in line with another European analysis by Pizzato et al from 2024 (32). The authors conclude that “Interestingly, our analysis failed to identify a significant relationship between the stringency of nonpharmaceutical interventions implemented by European countries and excess mortality.”

3 Behaviour and NPIs

As mentioned, the Covid-19 pandemic caused governments and authorities worldwide to impose NPIs. The goal was to induce people to change their behaviour, to reduce their physical interaction and thereby reduce the spread of the disease. In order to avoid a situation in which the health care system would not be able to treat the huge amount of people infected by the disease at a fast rate, people were encouraged by the authorities to avoid social contacts and stay at home, as described in (7). Avoiding physical interaction would, according to this strategy, while prolonging the duration of the pandemic, more importantly reduce the number of people in need of care at the same time. In February 2020, The Economist famously named this strategy ”flatten the curve” (33).

Our aim is to try to explain what could have had an impact on the physical interaction behaviour of the individuals in the EEA during the Covid-19 pandemic. Specific research questions include:

- Was it due to the individuals’ own consideration of the disease risk, the spread of the virus, and the risk of spreading it to others?
- Which impact did NPIs have on behaviour?
- How did that change when the majority of the EEA population was vaccinated?

3.1 Material and method

We use the following variables aggregated on national level in the analysis:

- **Stringency Index (%)**. The Oxford Stringency Index (23) is a daily measurement of the intensity of NPIs in different countries worldwide on a scale from 0 (no NPIs) to 100 (maximal NPIs) during 2020 - 2022, expressed as percent in this report. It covers nine different types of mandatory restrictions and recommendations: school closures, workplace closures, cancellation of public events, restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements, and international travel controls.
- **$\triangle$Mortality (%).** Excess mortality cf 2015 - 2019, as described in subsection 2.1 *Material and method* in section 2 *Mortality*.
- **$\triangle$Physical interaction (%) cf. 3 Jan - 6 Feb 2020**. We use the daily aggregated user data from Google Community Report (22) to measure the physical interaction during the pandemic. The data ”[s]how how visits and length of stay at different places change compared to a baseline. [...] Changes for each day are compared to a baseline value for that day of the week: The baseline is the median value, for the corresponding day of the week, during the 5-week period Jan 3–Feb 6, 2020.”

  The data are based on people with mobile appliances (phones) that had a Google account and had not actively turned off the ”location history”. It includes a variety of places where people gather to physically interact: grocery & pharmacy, transit stations, retail & recreation, and workplaces. In our analysis, we aggregate these categories into a single variable. According to Eurostat (34), 81 percent of the EU population used their mobile phones to access the internet in 2021. The data are available from 7 February 2020 - 15

October 2022.

- **ΔTemperature (°C) cf. baseline.** The difference in outdoor temperature in Celsius compared to the median value during the day during the baseline period, 3 Jan - 6 Feb 2020 (35). The movement to places where people meet normally varies during the year, with an increase during the warmer and brighter months. Also, the spread of the disease was positivity correlated with the outdoor temperature (36).

The regression analysis begins on 11 March 2020, the official start of the pandemic according to WHO (1), and ends on 14 September 2022 (the last date with weather data).

We use two regression models covering different time periods during the pandemic. The first one (I) covers the period before 50 percent of the adult EEA population were fully vaccinated, i.e. March 2020 - July 2021. The second one (II) covers the period after 50 percent of the adult EEA population were fully vaccinated, August 2021 - September 2022 (23). We compare our results between (I) and (II) to investigate if the correlation between the study variables and the physical interaction differed between the two periods.

A Hausman specification test suggests different model types for (I) and (II): a random effects model for (I) and a fixed effects model for (II). Therefore, we run two specifications for (I) and (II) respectively, one with random effects (a) and another one with fixed effects (b). The regression equation for (I) and (II) is as follows:

(I)
$$Physical\ interaction_{it} = \beta_{0(i)} + \beta_1 Stringency_{it} + \beta_2 \Delta Mortality_{it} + \beta_3 \Delta Temperature_{it} + \beta_4 Time_t + \epsilon_{it}$$

The regressions are weighted based on the population of the country (37).

3.2 Results

The physical interaction and the Stringency Index are illustrated by maps showing the average yearly value during the study period for each EEA country.

Figure 15, illustrating the physical interaction cf. 3 Jan - 6 Feb 2020 (%), shows a decrease during the pandemic in the EEA in 2020. In 2021, the populations in the EEA countries started to return to the pre-pandemic behaviour but were still at lower physical interaction levels cf. baseline. In 2022, most countries returned to a similar degree of physical interaction as before the pandemic. There were however differences. The Nordic EEA countries, for instance, had a lower level of physical interaction in 2022 compared with the baseline period. In contrast, many EEA countries in Eastern Europe and some popular tourist countries, such as Croatia, Greece, and Portugal, instead experienced an increase in physical interaction.

Figure 16 shows the evolution of the Stringency Index (%). Italy and Spain had a somewhat higher stringency than many other EEA countries and were also affected by a high excess mortality, especially at the beginning of the pandemic, as shown in Figure 6 and Figure 8 in section 2 *Mortality*. The restrictions in the EEA that were imposed in 2020 remained to a large extent during 2021. It was not until 2022 that the NPIs were mostly abolished. NPIs in 2022 mainly consisted of public information campaigns. Still some countries, for example Austria and Spain, kept some of the more extensive restrictions in place during 2022, such as restrictions on public gatherings.

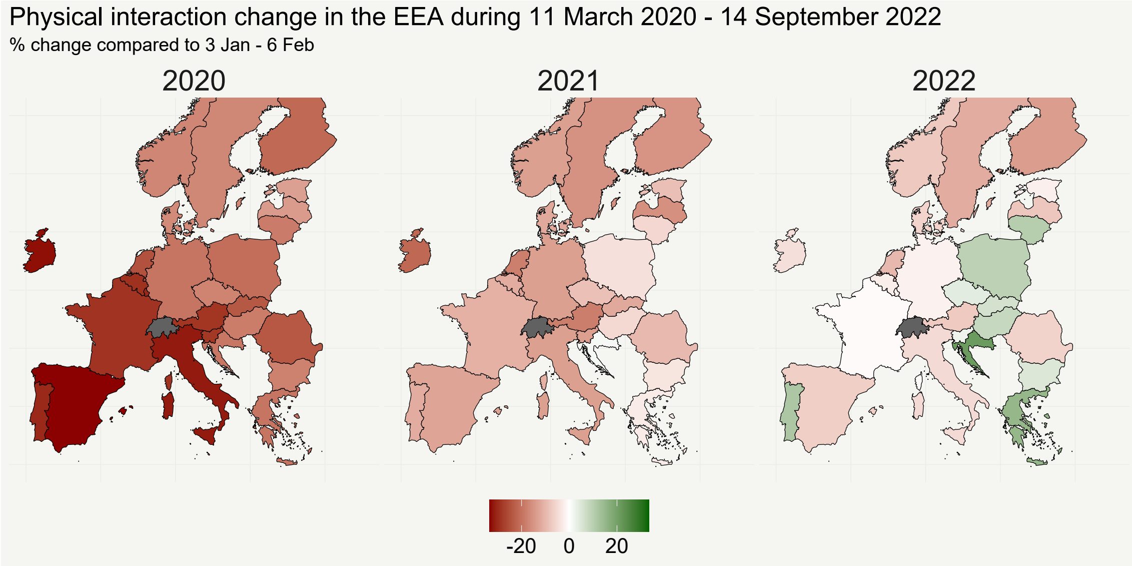


Figure 15. Physical interaction in the EEA between 11 March 2020 - 14 September 2022

Source: Calculations based on (22).

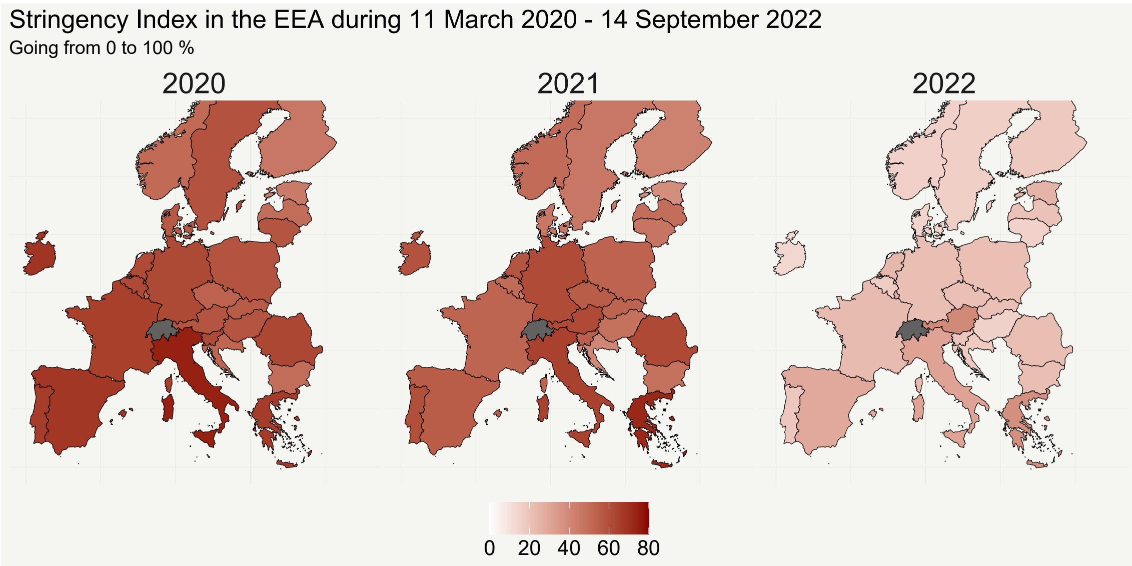


Figure 16. Stringency Index in the EEA between 11 March 2020 - 14 September 2022

Source: Calculations based on (23).

Figure 17 shows the development of the Stringency Index over time during 2020 - 2022 in the highlighted country groups in this report. The Nordic countries had a lower degree of NPIs at the start of the pandemic (mainly driven by Sweden, which can be seen in section 4 *Behaviour and NPIs in Sweden*) than the other highlighted country groups. Apart from a brief period during the summer of 2020 and spring of 2021, the Nordic countries continued to have less NPIs than the other two groups.

As for the behaviour over time during 2020 - 2022, illustrated in Figure 18, the Nordic countries had the smallest relative behavioural changes during the first three months of the pandemic (also driven by Sweden, which can be seen in section 4 *Behaviour and NPIs in Sweden*). For most of the remaining pandemic, it was instead the highlighted Eastern European countries that had the least behavioural impact. In June 2021, the country group had reached a higher level of

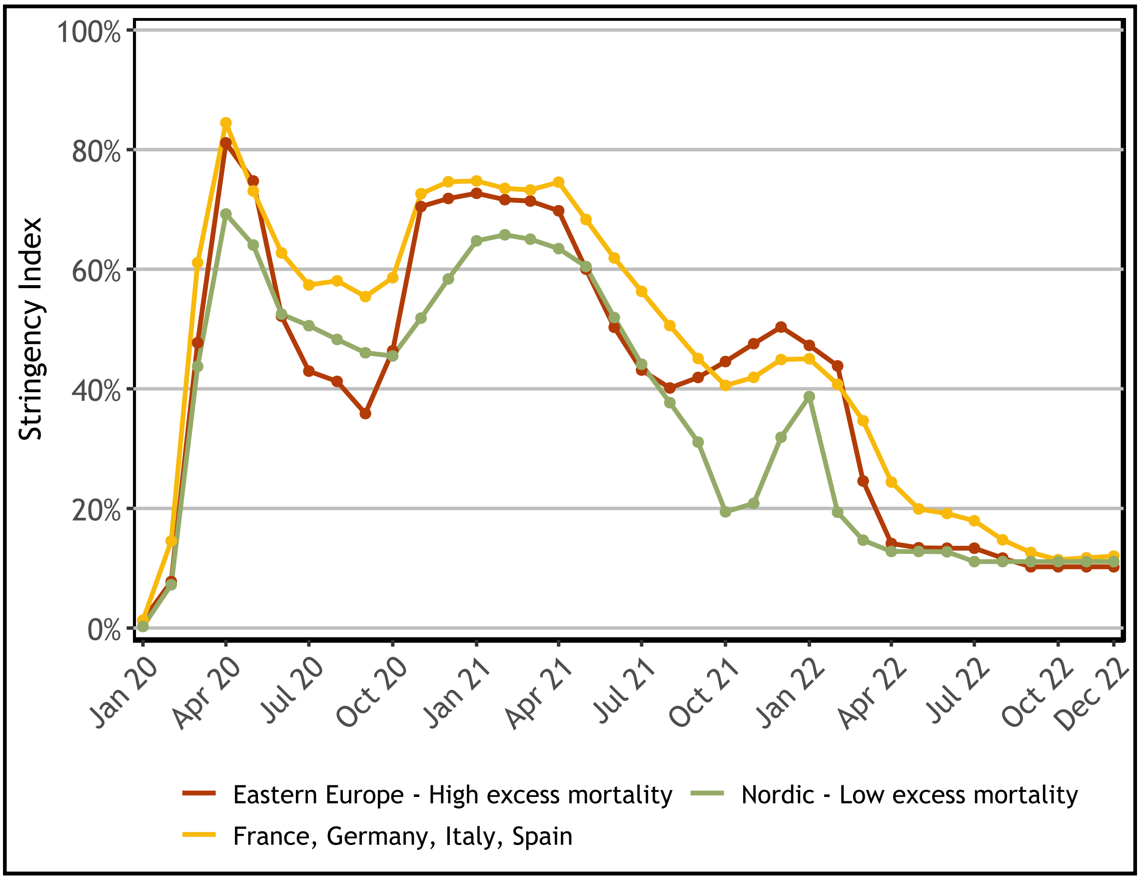


Figure 17. Stringency index in the investigated groups

Source: Calculations based on (23).

Note: The average values for the groups are weighted by the population in the countries within the groups.

physical interaction than during the baseline period before the pandemic.

Notably, the Nordic countries as a group never returned to their original pre-pandemic behaviour. Not even after the majority of the adult population had been vaccinated in August 2021 (see Figure 12 in section 2 *Mortality*) or the NPIs had been mostly abolished in the countries in March 2022. Much of this was a consequence of a decreased mobility to workplaces. In the highlighted Eastern European countries, people instead returned to their physical workplaces resulting in a restoration of the physical interaction.

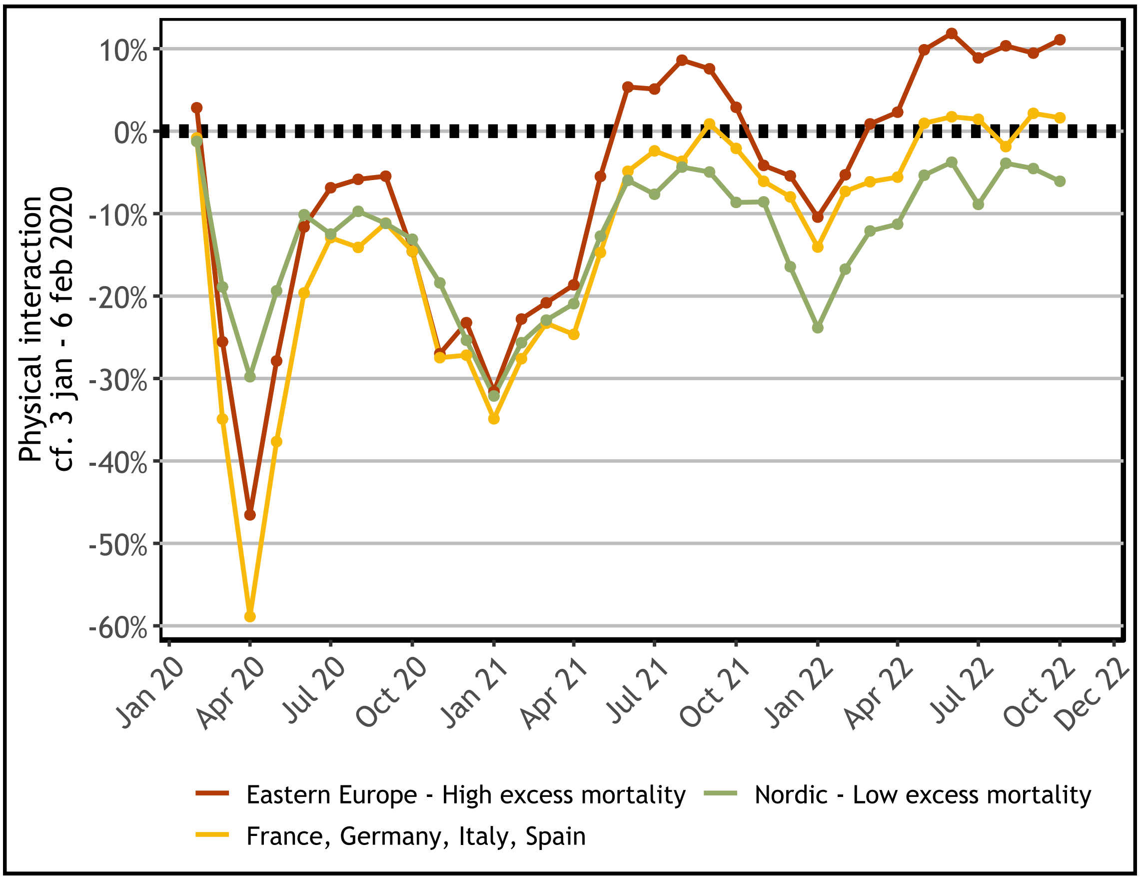


Figure 18. Physical interaction in the investigated groups

Source: Calculations based on (23).

Note: The average values for the groups are weighted by the population in the countries within the groups. The Google data cover the period 7 February 2020 - 15 October 2022.

Table 1 presents the results from the regression analysis of the correlations between the investigated variables on physical interaction. The results are presented for the period before half of the adult EEA population was fully vaccinated (Ia) and (Ib) and the period after this (IIa) and (IIb). We mainly comment on the differences between (I) and (II) in general due to the negligible differences between the random (a) and fixed effect (b) models for the same time period.

Prior to the majority of the EEA population had been vaccinated (I), two variables, the Stringency Index and the excess mortality, were significantly negatively correlated with the physical interaction. The other two variables, the difference in the outdoor temperature cf. baseline and the duration of the pandemic, were significantly positively correlated with the physical interaction.

In (II), after a majority of the adult EEA population had been fully vaccinated, the negative correlation between the stringency and the physical interaction was significantly weaker compared to the time period (I). The same difference between (I) and (II) can be observed for the correlation between the excess mortality and the physical interaction. The correlation between the excess mortality and the physical interaction in (II) was also lower than in (I). When using a fixed effect model (IIb) this correlation is not even significant at the 95 percent level, even if this is still the case when using random effects (IIa).

Table 1. Physical interaction cf. baseline in the EEA during 11 March 2020 - 14 September 2022

	Mar 2020 - Jul 2021		Aug 2021 - Sep 2022	
	Ia	Ib	IIa	IIb
Intercept		1.64		10.61^*
		$[-3.48; 6.77]$		$[3.94; 17.28]$
Stringency Index (%)	-0.62^*	-0.61^*	-0.21^*	-0.21^*
	$[-0.69; -0.55]$	$[-0.67; -0.54]$	$[-0.27; -0.15]$	$[-0.27; -0.15]$
ΔMortality (%) cf. 2015-2019	-0.12^*	-0.12^*	-0.04^*	-0.03
	$[-0.16; -0.09]$	$[-0.16; -0.09]$	$[-0.07; < 0.00]$	$[-0.07; > 0.00]$
ΔTemperature (°C) cf. baseline	0.63^*	0.64^*	0.58^*	0.58^*
	$[0.51; 0.75]$	$[0.53; 0.76]$	$[0.51; 0.64]$	$[0.51; 0.65]$
Months since March 2020	1.52^*	1.52^*	-0.43^*	-0.43^*
	$[1.40; 1.64]$	$[1.40; 1.64]$	$[-0.63; -0.24]$	$[-0.63; -0.24]$
Country effects	Fixed	Random	Fixed	Random
χ^2-statistic		2178.28		674.68
F-statistic	533.59		168.85	
R^2	0.82	0.81	0.66	0.65
Adj. R^2	0.81	0.81	0.64	0.64
Num. obs.	459	459	378	378

* Null hypothesis value outside the 95 % confidence interval. Note: The regressions are weighted by the population in the studied countries. The baseline is 3 Jan - 6 Feb 2020. The values within the parentheses are the confidence interval. (I) is the time period before half of the EEA population was vaccinated and (II) is the preceding period.

The correlation of the duration of the pandemic in (II) is the opposite to (I). Instead of an increase of physical interaction over time all other things being equal as in (I), we notice a decrease in (II).

Our study variables are more correlated with the behaviour before (I) than after (II) the majority of the adult population had been fully vaccinated. Still, the high R^2 values in the models for both time periods suggest that most of the variation in the physical interaction in the EEA during the Covid-19 pandemic is correlated by the covariates that we use.

The cross-sectional unconditional correlation between the physical interaction and the Stringency Index for each month of the study period is further shown in Figure 19. There is a significant reduction in the degree of the correlation after the second half of 2021 compared to the preceding period. It should, however, be noticed that the correlation becomes stronger again during 2022, once the stringency was reduced to low levels as was to be seen in Figure 16.

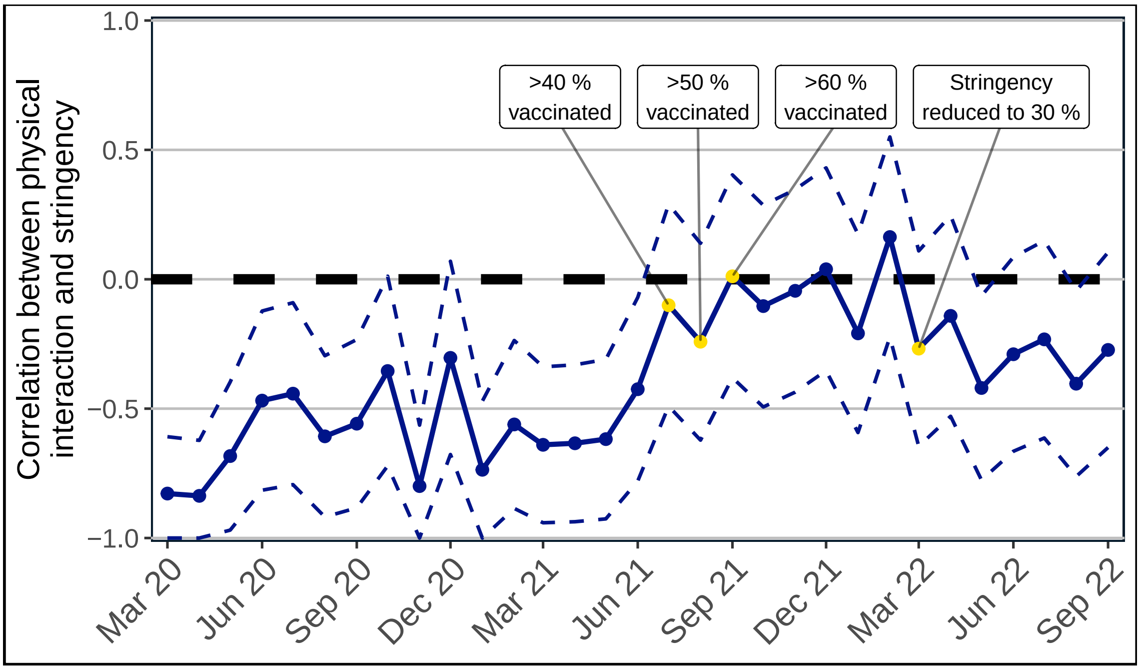


Figure 19. Correlation between physical interaction and Stringency Index in the EEA during 11 March 2020 - 14 September 2022.

Source: Calculations based on (22) and (23).
Note: The dotted lines mark the confidence interval. The correlation is weighted by population.

3.3 Discussion

Our analysis confirms that people reduced their physical interaction in the EEA during the Covid-19 pandemic. At its official start in March 2020, all countries saw a sharp decline in the physical interaction, a decrease which had mostly vanished at the end of our analysis period in September 2022.

The perception of the disease risk of the individual influenced the behaviour during the pandemic. This perception was influenced by the NPIs, the excess mortality, the outdoor temperature, and the vaccines. These variables provided information to the individual regarding the disease risk. Still, the degree of the correlation between the physical interaction and the NPIs as well as the excess mortality weakened after half of the adult EEA population had been fully vaccinated, i.e. period (II) in our regression analysis. During the 3rd and 4th quarters of 2021, physical interaction almost returned to the pre-pandemic baseline. This increase in physical interaction was however not correlated with a clear softening of the NPIs in the EEA countries. Between March 2022 and September 2022, when the NPIs were reduced to 30 percent and below, we once again observe a stronger correlation between the physical interaction and NPIs reflecting an acceptance with the weaker restrictions.

This increase in physical interaction shows that individual behaviour responds to changes in incentives. Compliance with the NPIs seemingly weakened as time passed, which was shown in Figure 19. As the pandemic wore on, people returned to interact physically, even if the NPIs were not immediately adjusted after the majority of the adult population had been fully vaccinated.

Before half of the adult EEA population was fully vaccinated, there was also, other things being equal, a positive correlation between the duration of the pandemic and the physical interaction. From previous research, we know that people's concern regarding the social and economic consequences of the reduction in physical interaction grew as the pandemic prolonged (26, 38). One possible explanation for people being less compliant with the stringency in the EEA over time might thus be that the individual perception of the costs of the behavioural changes increased over time.

After a majority of the people had been fully vaccinated, the opposite correlation is observed. Initially, when people had received a pharmaceutical intervention, a protection, making it safer to physically interact again after over a year of restricted behaviour. In a longer time perspective however, there might have been a gradual adaptation to a, in some aspects, changed behaviour with less physical interaction than before the pandemic. For instance, there has been an increased possibility of teleworking following the Covid-19 pandemic (39). This might, other things being equal, explain the negative correlation between physical interaction and time.

4 Behaviour and NPIs in Sweden

Sweden received worldwide attention during the Covid-19 pandemic for supposedly following a different path to handle the pandemic with less behavioural changes and a lower level of NPIs (40). In this chapter we aim to investigate the behaviour and NPIs in Sweden compared with the EEA. It is based on a previous Swedish publication by IHE in Läkartidningen (41).

How extensive were the Swedish NPIs in relation to those introduced in the other EEA countries? To which degree did the Swedes change their physical interaction compared to other EEA countries over time?

4.1 Material and method

We show the development of the following variables over time for Sweden versus the rest of the EEA:

- **Stringency Index (%).** As described in subsection 3.1 *Material and method* in section 3 *Behaviour and NPIs*
- **△Physical interaction (%) cf. 3 Jan - 6 Feb 2020**. As described in subsection 3.1 *Material and method* in section 3 *Behaviour and NPIs*.

The analysis stretches from 7 February 2020 to 15 October 2022, i.e. the period with available data over physical interaction.

4.2 Results

In Figure 20, the dashed line shows how the Stringency Index varied in Sweden compared to the other EEA countries over time. During the first three months, February - April 2020, Sweden was an outlier as one of the EEA countries with the lowest level of NPIs. However, in May 2020, the other EEA countries started to reduce their NPIs. In June of the same year, the other EEA countries had, on average, a lower level of NPIs than Sweden. The reason was that Sweden maintained much of the NPIs during the summer and autumn of 2020 while other EEA countries reduced their NPIs.

In August 2021, when half of the adult population in the EEA had been fully vaccinated, Sweden again chose another path than the other EEA countries. Sweden started to reduce the NPIs much more than other EEA countries. At the end of 2021, during October - December, Sweden had the lowest level of NPIs in the whole EEA.

The solid line in Figure 20 illustrates the changes in physical interaction during the pandemic compared to the baseline median for each country from 3 January to 6 February 2020. Again, Sweden stood out at the beginning of the study period. During March - May 2020, the behaviour was closer to baseline in Sweden than in any other EEA country. In July 2020, the rest of the EEA population started to increase its physical interaction again.

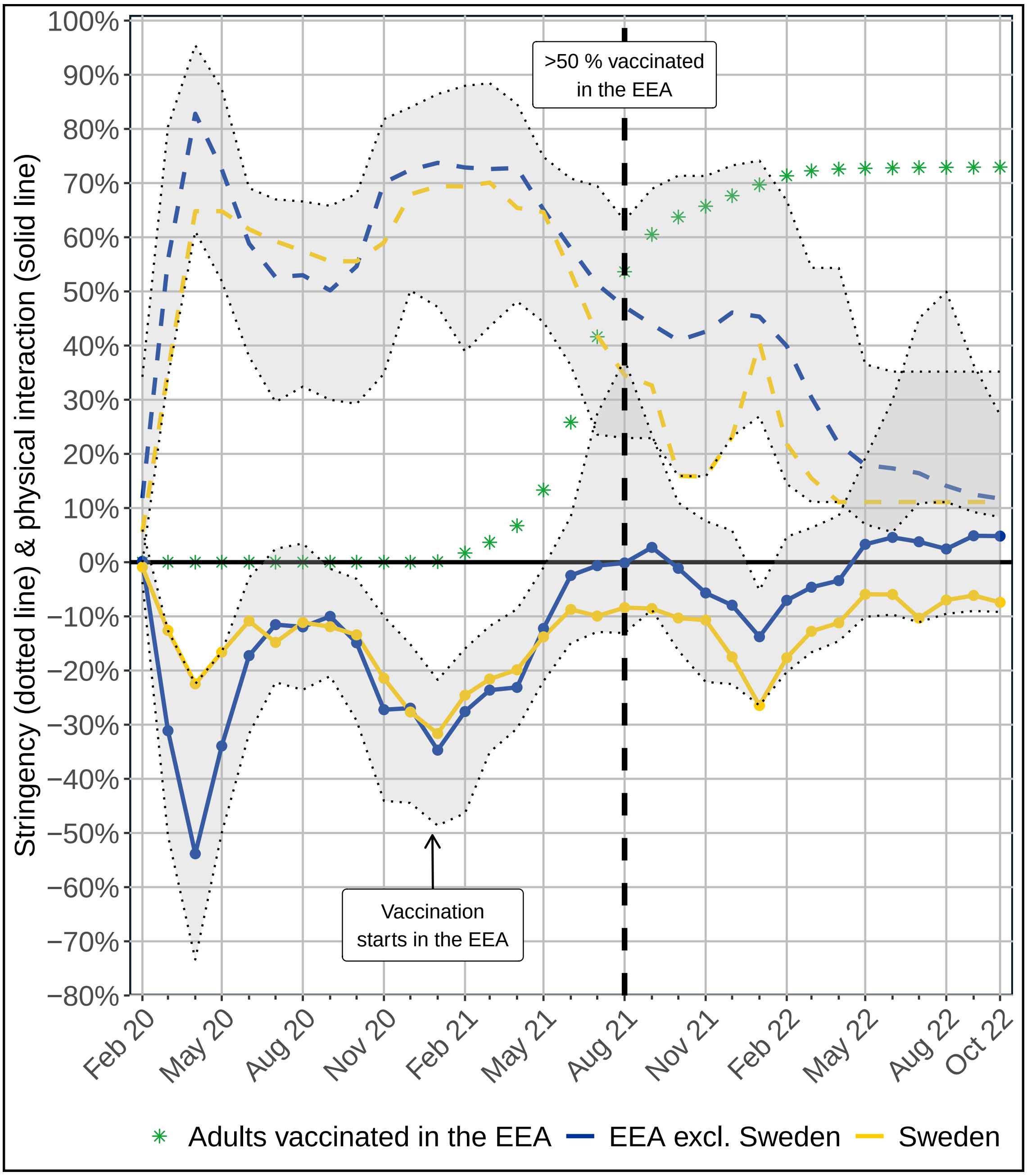


Figure 20. Physical interaction and Stringency Index in the Sweden compared to the other EEA countries

Source: Calculations based on (22) and (23).

Note: The grey areas represent the max and min values in the EEA as a whole. The average in the EEA is weighted by population.

By June in 2021, Sweden had a lower degree of physical interaction than the rest of the EEA compared to their pre-pandemic behaviour. As more people were vaccinated, the rest of the EEA population gradually returned to its previous behaviour, despite the measures largely remaining in place. This was however not the case in Sweden which population continued with its reduced physical interaction even after the NPIs were mostly abolished and people had received vaccine. The Swedish population did not return to its pre-pandemic behaviour during the study period.

4.3 Discussion

Sweden chose a less restrictive path than other comparable countries at the start of the pandemic with notably lower NPIs and a lower reduction in its physical interaction than any other EEA country.

Much of the measures imposed in Sweden instead relied on advice from authorities and voluntary behavioural changes. One important explanation is that the Swedish constitution guarantees free movement for its inhabitants. The national authorities in the country are not directly controlled by politicians and can thus act more independently than those in other countries. In addition, the regions in Sweden are in several aspects independent of the state and state authorities in important areas of responsibility such as healthcare and transport (4).

Following a reduction in the NPIs and an increase in the physical interaction in the other EEA countries, Sweden was no longer an outlier after the summer of 2020.

On 8 January 2021, a temporary pandemic law was introduced in Sweden, act 2021:4, allowing the government to impose special restrictions to prevent the spread of Covid-19 disease. It enabled the government to close public transport, shops, and public places to prevent the spread of infection (42). On 17 February 2021, the government presented new initiatives with the support of the temporary pandemic law (43).

As seen in Figure 6 in section 2 *Mortality*, Sweden had the lowest excess mortality in the EEA in 2020 - 2022. This may seem remarkable given the fact that Sweden for a long period was among the EAA countries with the least strict NPIs and also experienced the smallest reduction in physical interaction of all the EEA countries.

5 QALY in Sweden and Norway

In this chapter, we aim to investigate the health loss due to excess mortality measured in the QALY loss and compare it with the health loss from reduced QoL (based on an HRQoL questionnaire described in the method section of this chapter), also measured as QALY loss, for the in the general population in Sweden and Norway during the pandemic.

As mentioned earlier in section 4 *Behaviour and NPIs in Sweden*, Sweden chose a less restrictive path than the other EEA countries during the beginning of the pandemic. One of the factors behind this was, as mentioned, that the Swedish constitution, in the sense of its division of power, prevented many of the strict measures imposed in many other countries. In Norway however, there were no such limitations to closing down the society. Thus, Norwegian politicians and national authorities were free to implement stricter NPIs in Norway. Both factors, the pandemic and the NPIs, can be expected to have an impact on the Health-Related QoL of the population. The objective of this chapter is to estimate the impact of the pandemic and of NPIs on the HRQoL of the Swedish and Norwegian adult population during the outbreak of the Covid-19 pandemic.

5.1 Material and method

A study was conducted in two Nordic countries, Norway and Sweden. The purpose was to estimate the health loss, QoL, due to excess mortality and the health loss for the general population at risk that to some extent could be related to NPIs, in the two countries. The health loss due to excess mortality for the three years of the Covid-19 pandemic was estimated by using the methodology developed by Briggs (2021) (44).

In brief, this means that the amount of QALYs lost due to premature death is calculated in three steps. First, the number of expected life-years lost is calculated based on survival statistics for the general population. Secondly, these life-years lost are multiplied by the QoL according to population norms. Thirdly, the QALYs lost are discounted to account for the lower value of future QALYs lost as compared to QALYs lost in the present. A three percent discount rate is applied.

The outbreak of the Covid-19 pandemic resulted in various international and national strategies, including NPIs such as social distancing and travel bans, which have purportedly mitigated the health loss due to the pandemic. Both these factors, the pandemic and the NPIs, can be expected to have an impact on the HRQoL of the population.

The health loss for the general population was estimated by using two web-based surveys sent to randomized samples of the adult Norwegian and Swedish population. The changes in health were measured by comparing the general populations HRQoL before the pandemic with the general population's HRQoL during the pandemic when NPIs were imposed.

The pre-pandemic estimate was conducted in February 2020 in Sweden (n=1,016) by using data from (26). In Norway, the pre-pandemic estimate used in this report is from December 2019 (n=3,200) (45).

Data during the pandemic was collected during the same months for both countries. For the first wave, data were collected in April 2020 (n=1,003), one month after the outbreak. For the second wave, data were collected in January 2021 (n=1,013), after ten months living with the pandemic. HRQoL was measured using the EQ-5D-5L mesurement in the surveys conducted during the pandemic, whereas the Visual Analogue Scale (VAS) was used in both the surveys conducted before and after the pandemic outbreak. In Sweden, the Stringency Index during our first measurement was 65 and during the second survey 70. In Norway, the stringency index during the first measurement was 76 and during the second 65.

The questionnaire included informed consent, background questions (age, sex, number of household members, education, occupation, and income) and a question on HRQoL using the VAS, a rating scale from 0 (the worst imaginable health state) to 100 (the best imaginable health state) where the respondent is asked to rate their current health. The two pandemic surveys in April 2020 and January 2021 also included the EQ-5D-5L (a questionnaire that can be used to indirectly derive the health state utility values using value sets that was developed based on a time-tradeoff technique survey on the general population). A four-item Patient Health Questionnaire for anxiety and depression and questions related to perception and experience of Covid-19 was also included. Public information regarding the pandemic provided concern about Covid-19 with respect to the economic situation for the foreseeable future, health, and social situation of the individual.

The QALY loss due to excess mortality for Sweden and Norway was estimated for each of the full years 2020, 2021, and 2022, respectively (28, 46). The comparison the QALY loss due to excess mortality and the QALY loss for the general population thus results in a comparison between the health loss in the general population only for two months with the health loss on the one hand with the excess mortality during the whole of 2020 and the whole three-year-period on the other hand.

5.2 Results

The results for Sweden, illustrated in Figure 21, show a reduction in average HRQoL in the adult population, with 0.059 points reduction in April 2020 and 0.074 points reduction in January 2021, compared to the pre-pandemic estimate in February 2020. This reduction in HRQoL was significant only for responders in the ages below 65. For the elderly, i.e. in age groups 65+, where most of the excess mortality was registered, there was no significant decline in HRQol between the survey periods and the pre-period. The fact that loss in HRQoL was significant only among respondents in the working age population (below 65 years) suggests that the social and economic impact of NPIs were the primary drivers for this specific cohort.

In Norway, the point estimates of the health-related QALY loss were higher than the one in Sweden during the two single months April 2020 and January 2021. There was however no statistically significant difference compared to Sweden.

The excess mortality in Sweden during the first year of the pandemic, 2020, in Sweden was 6,900 people (28). This mortality generated a total loss of 30,000 QALYs in the general population. In Norway, no excess mortality was registered for 2020. Instead, the country had a lower excess mortality in 2020 compared to the previous five years.

The sum of QALY loss due to excess mortality for all three years (2020 - 2022) was estimated to 45,000 for Sweden and 29,400 for Norway. This can be compared to the health related QALY loss in the general population for the two investigated months, April 2020 and January 2021: In Sweden, the QALY loss for the general population was estimated to 51,000 for the single month of April 2020 and to 53,000 for the single month of January 2021. In Norway 37,000 QALYs for April 2020 and 40,000 in January 2021 in Norway.

In Figure 22, the QALY loss in Sweden per capita is illustrated. In (a), the QALY loss in the general population for the single months of April 2020 and January 2021 are shown respectively compared to the QALY loss from the excess mortality from the whole year 2020. In (b), the same QALY loss in the general population in Sweden is shown in contrast to the QALY loss due to the mortality during all three years, 2020 - 2022. Figure 23 shows the corresponding figures for Norway.

The results show that the QALY loss in the general population in both April 2020 and January 2021 was significantly larger in both countries than the QALY loss from the excess mortality during the whole of 2020. In Norway, the QALY loss in the general population during these two single months was also significantly larger than the one from the excess mortality during all three years, 2020 - 2022.

The QALY loss in the general population was primarily comprised of worry (e.g. regarding economy, social isolation, or getting ill) among the younger part of the population. Both these estimates are based on comparison between April 2020 and the pre-measurement in December 2019 in Norway and February 2020 in Sweden.

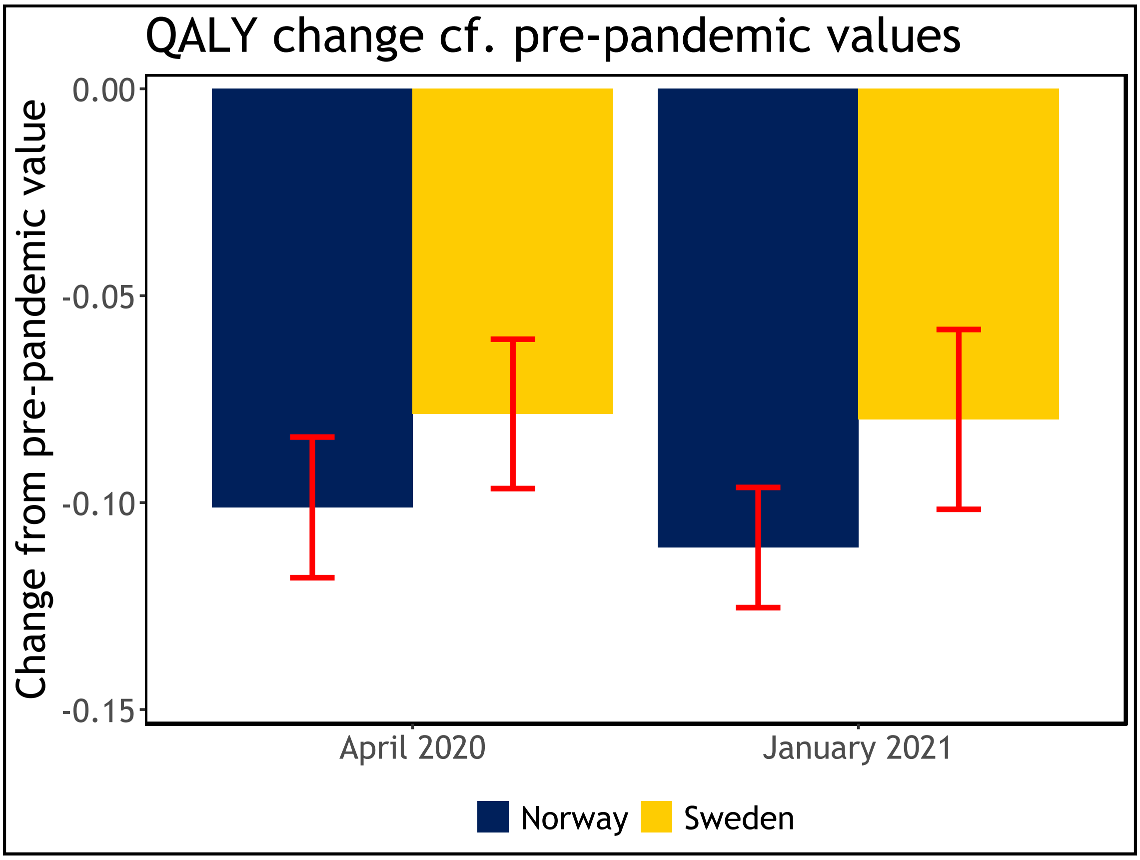
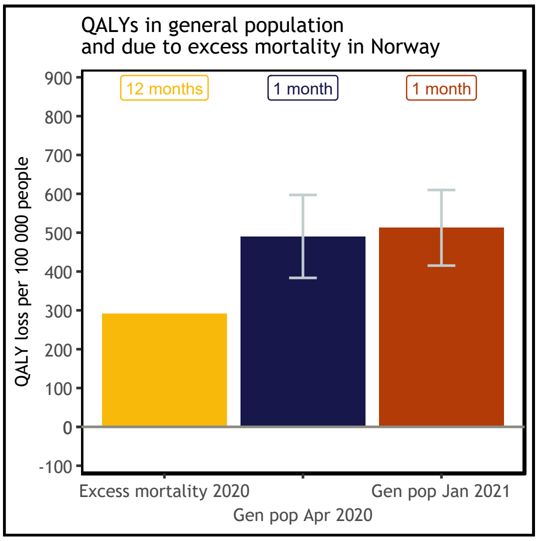
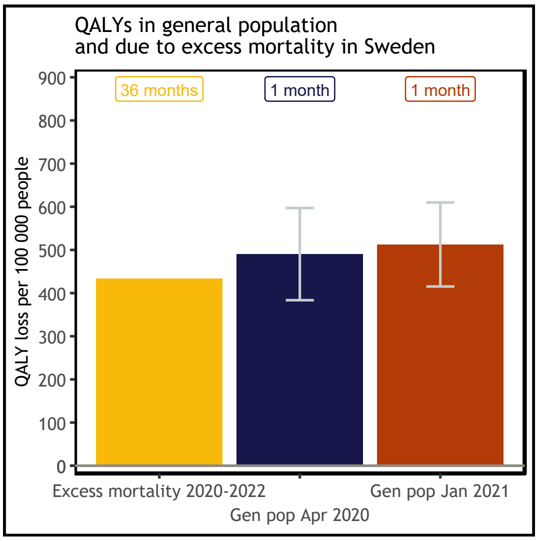


Figure 21. QALY compared to the pre-pandemic value in February 2020

Source: Calculations based on data from (26, 45). Note: The QALY losses in the general population are the sum over the significant age groups in the data.



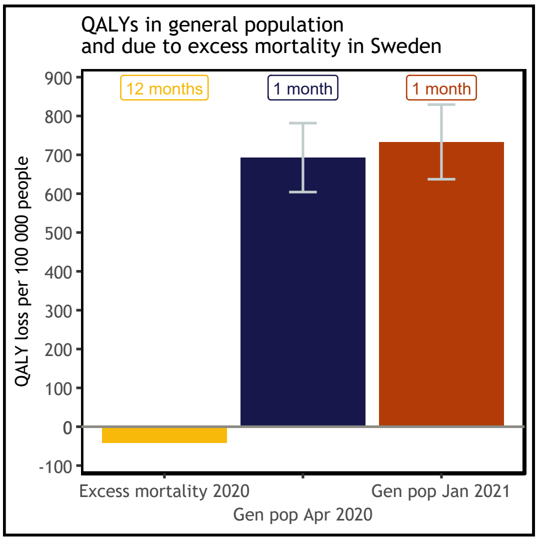
(a) QALYs lost versus the mortality in 2020



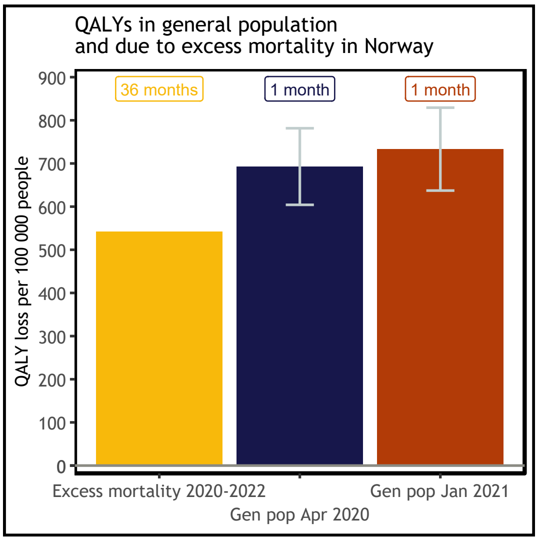
(b) QALYs lost versus the mortality in 2020-2022

Figure 22. QALYs lost in the general population and due to mortality in Sweden

Source: Calculations based on data from (26, 28, 45, 46). Note: The QALY losses in the general population are the sum over the significant age groups in the data.



(a) QALYs lost versus the mortality in 2020



(b) QALYs lost versus the mortality in 2020-2022

Figure 23. QALYs lost per capita in the general population due to mortality in Norway

Source: Calculations based on data from (26, 28, 45, 46). Note: The numbers for the QALY losses are the sum over the significant age groups in the data.

5.3 Discussion

Our estimates of health loss in the general populations in Sweden and Norway should ideally have been measured for the entire three-year period, when the NPIs and risk of getting infected were expected to impact the HRQoL of the general population. However, we only had the opportunity to measure this during two limited time periods, one month each, in Norway and Sweden. Since the NPIs (measured by the Oxford stringency index) vary over time, higher stringency index during winter periods and for periods with high excess mortality rates, we cannot extrapolate QALY loss for periods when data is lacking. Despite the limited time frames, we estimated health loss in the general population for two months only, are higher than the entire health loss due to excess mortality for three years, both in Norway and Sweden.

It should also be noted that the excess mortality reported in this study may be followed by an excess mortality deficit. As could be seen in Figure 10 in section 2 *Mortality*, during July and October 2020, the observed excess mortality in Sweden was actually somewhat lower compared to the average for the same months in 2015-2019. This is according to expectations as the deaths mainly occurred in older individuals with a high level of comorbidity that would have died later during the pandemic period for other reasons if they would not have been infected by Covid-19.

VAS instrument may be more responsive compared to the indirect measurement of QoL using the EQ- 5D. The EQ-5D is designed to capture the QoL in five health-related dimensions, while VAS is designed to rate health on a scale from ”worst possible” to ”best possible”.

6 GDP

The aim of the final part of our analysis in this report is to investigate if the GDP-losses were correlated with NPIs and decrease in physical interaction in the EEA during the Covid-19 pandemic. Thereby, we want to estimate the economic cost of NPIs and behavioral changes in terms of GDP. How did the GDP develop in different EEA countries during the Covid-19 pandemic? Why did some countries see a sharper decline than others? Why did some countries recover better than others? To which extent was the decline and recovery connected to differences in NPIs and physical interaction?

6.1 Material and method

We conduct our analysis quarterly (the GDP data is not available on a finer timescale) between the pandemic years 2020 and 2022. The regression analysis ends in the third quarter of 2022 due complete availability of the behavioural data used in the study not being available for the forth quarter in 2022. Based on the different phases in GDP development that have been observed over the pandemic in each of the EEA countries (24), we divided the analysis into two periods:

1. The recession period, Q1 2020 - Q2 2020, when all EEA countries experienced a decline in GDP, even though the size of the decrease varies across EEA countries.

2. The recovery period, Q3 2020 – Q3 2022, when all EEA countries started to recover from the recession, to various degrees.

We use available aggregated data on national level in the analysis:

- **GDP gap (%)**. The GDP variable is quarterly chain-linked GDP data from Eurostat, seasonally- and calendar-adjusted at market prices (24). We calculated percentage point changes in GDP, the GDP gap, separately for each EEA country as the difference between actual and expected quarterly GDP during 2020 – 2022. Expected GDP is calculated using a quarterly linear extrapolation of average GDP-development between 2015 and 2019 in each country. We add expected growth to actual GDP in the pre-pandemic index year 2019.

- **Stringency Index (%)**. As described in subsection 3.1 *Material and method* in section 3 *Behaviour and NPIs*.

- **△Physical interaction (%) cf. 3 Jan - 6 Feb 2020**. As described in subsection 3.1 *Material and method* in section 3 *Behaviour and NPIs*.

- **△Labour cf. 2019**. The inverse of the quarterly percentage point change in labour slack compared to the corresponding quarter in the pre-pandemic year 2019, seasonally adjusted and for people aged 15 - 74. The labour slack is the available proportion of the labour force not in an occupation. The largest category in the labour slack consists of unemployment, but it also covers a broader spectrum of people able to work but not in an occupation, that could contribute to increase the GDP in the country. The data comes from Eurostat and its definition comes from the International Labour Organization and the three supplementary indicators, in addition to the unemployment, is as follows (47):

    - Underemployed part-time workers, people working part-time who wish to work additional hours and are available to do so.

  - People seeking a job but not immediately available to work.
  - People available to work but not seeking, persons that are neither employed nor unemployed but who want to work.

- **Teleworkable occupations 2018 (%).** The proportion of employed people in each EEA country in 2018 with an occupation feasible for telework, independent of the allowances of actually doing so. These data are based on a study using the International Standard Classification of Occupations (48). The variable is time-invariant and based on data before the outbreak of the pandemic. Later evidence has however shown that the proportion of potential teleworkers was only marginally changed in the EU countries following the pandemic, on average 1.5 percentage points (49).
- **GDP gap Q1 & Q2 2020.** The GDP gap on average during the recession period in each country (24). It is used to control for the potential effect of the degree of GDP loss during the recession on the GDP gap during the recovery period (see the two following sections).

To investigate the correlation between the GDP gap (%) and the other variables, we use panel data regressions with random effects. The choice of random effects was made following a Hausman specification tests between fixed versus random effects. We preform two regressions, one for the economic recession period (III) and one for the recovery period (IV) respectively:

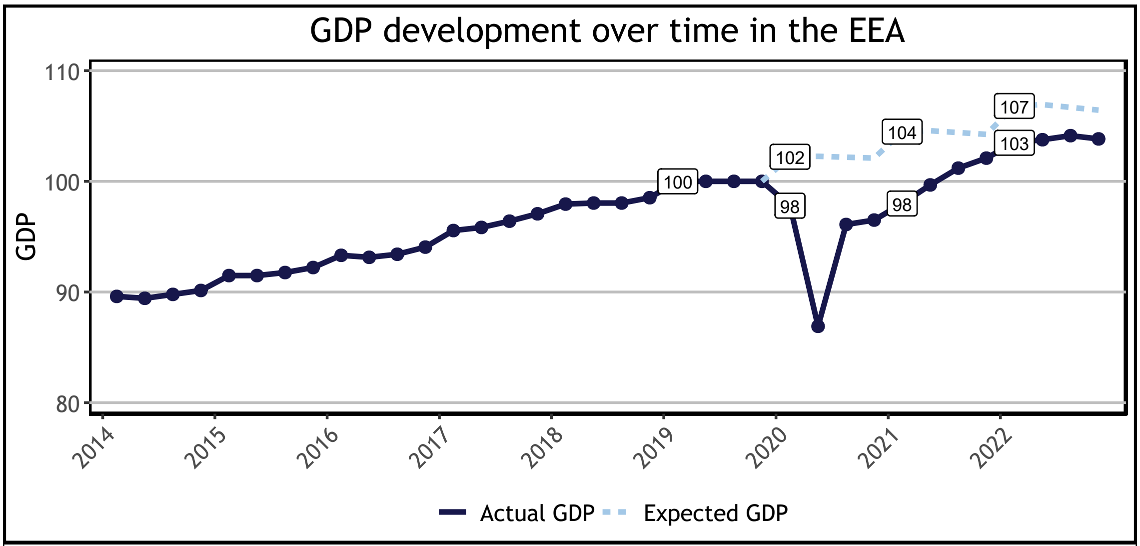
(III)
$$\begin{aligned} GDP\ gap_{it} = &\ \beta_0 + \beta_1 Stringency_{it} + \beta_2 \Delta Physical\ interaction_{it} \\ &+ \beta_3 Teleworkable\ \ occupations\ \ 2018_i \\ &+ \beta_4 \Delta Labour_{it} + \epsilon_{it} \end{aligned}$$

(IV)
$$\begin{aligned} GDP\ gap_{it} = &\ \beta_0 + \beta_1 Stringency_{it} + \beta_2 \Delta Physical\ interaction_{it} \\ &+ \beta_3 Teleworkable\ \ occupations\ \ 2018_i \\ &+ \beta_4 \Delta Labour_{it} + \beta_5 GDP\ gap\ Q1\ \&\ Q2\ 2020_i + \epsilon_{it} \end{aligned}$$

The observations are weighted by their total GDP (50).

6.2 Results

The quarterly actual and expected GDP-development in the EEA as a whole compared to the index year 2019 can be seen in Figure 24. During Q1 and Q2 2020, there was a sharp decline in GDP in the area. Thereafter, the economy started to recover and in Q3 2021, the EEA had a higher actual GDP than before the pandemic (Q4 2019). However, the GDP never reached the expected value were it not for the pandemic. On average during 2020 - 2022, the actual GDP was 4.8 percent lower compared to the expected GDP.



2020	2021	2022	2020 - 2022
-7.7 %	-4.0 %	-2.7 %	-4.8 %

Figure 24. Actual and expected GDP over time in the EEA

Note: Index year = 2019. The infoboxes are placed at Q1 in the respective year. Weighted average based on the GDP in each EU country in accordance with the EU27 data series from Eurostat. Norway is not included in this series, since it is a part of the EEA but not the EU, whereas Cyprus, otherwise excluded in the analysis, is included here. However, due to the size of their economies, this does not affect the outcome described in the figure.

Source: Calculations based on (24).

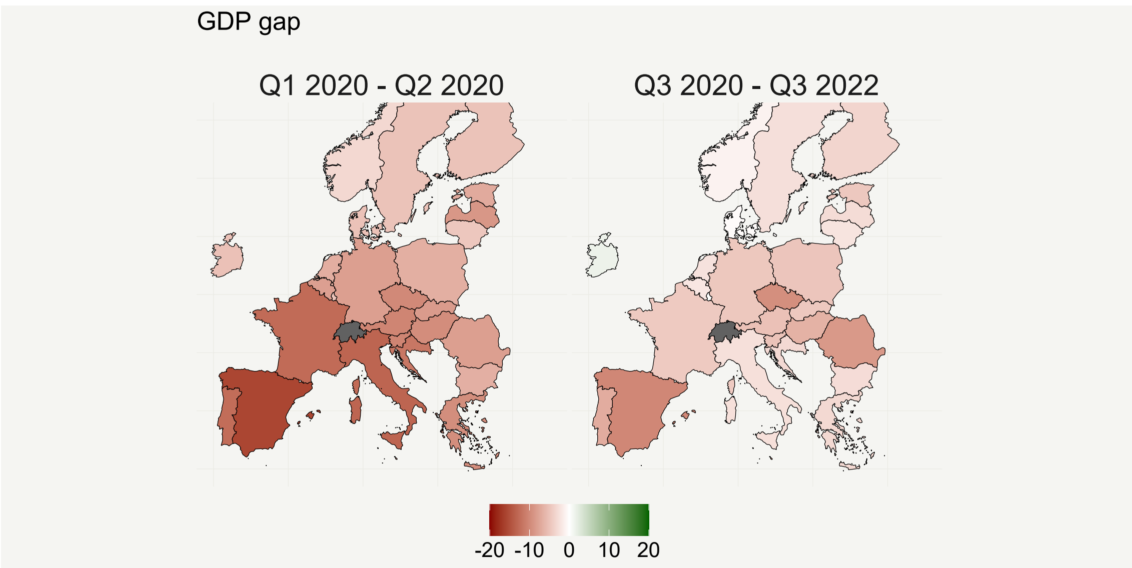


Figure 25. GDP gap (percentage point difference)

Source: Calculations based on (24).

For the average GDP-development during the recession and recovery periods, as analysed in the regression analysis, among the individual member states in Figure 25, a decline in GDP in Q1 – Q2 2020 can be seen for all countries. There were, however, notable differences between countries. For instance, Spain and Italy experienced a sharper decline than Lithuania and Sweden.

From Q3 of 2020, the GDP started to increase in all countries. However, this growth was not enough to fully compensate for the loss in Q1 – Q2 2020, except for Ireland and Luxembourg. On average during Q3 2020 – Q3 2022, all other EEA-countries had a lower GDP than expected, based on the growth between 2015 and 2019 in each country.

Table 2. GDP gap (percentage point difference) over time in the EEA countries

	(III) Q1 2020 - Q2 2020	(IV) Q3 2020 - Q3 2022
Intercept	-3.46	-14.36^{*}
	$[-10.87; 3.95]$	$[-24.55; -4.17]$
Stringency Index (%)	-0.08^{*}	> 0.00
	$[-0.14; -0.03]$	$[-0.02; 0.01]$
$\triangle$Physical interaction (%)	0.37^{*}	0.09^{*}
	$[0.26; 0.47]$	$[0.06; 0.13]$
Teleworkable occupations 2018 (%)	0.18	0.37^{*}
	$[-0.01; 0.37]$	$[0.14; 0.60]$
$\triangle$Labour cf. 2019	-0.27	0.24^{*}
	$[-0.90; 0.36]$	$[0.07; 0.41]$
GDP gap Q1 & Q2 2020		0.22^{*}
		$[-0.05; 0.50]$
χ^2-statistic	670.26	155.11
R^2	0.87	0.26
Adj. R^2	0.86	0.24
Num. obs.	54	243

* Null hypothesis value outside the 95 % confidence interval.
Note: The regressions are weighted by the total GDP in the studied countries. The baseline of the physical interaction is 3 Jan - 6 Feb 2020. $\triangle$Labour and GDP gap are expressed as percentage point differences. The values within the parentheses are the confidence interval.

Table 2 presents the quarterly based regression results for the correlation between the investigated variables and the GDP gap for the recession period (III) and the recovery period (IV).

During the recession period (III), two of the covariates were significantly correlated with the GDP. The Stringency Index was negatively correlated with the GDP and the amount of physical interaction was positively correlated with the GDP. The covariates representing the situation on the labour market, the proportion of teleworkable occupations and labour, were not significantly correlated with the GDP.

During the recovery period (IV), the Stringency Index was not significantly correlated with the GDP. The physical interaction was still positively correlated with it, but its correlation was significantly lower in (IV) than in (III). In contrast to (III), the variables representing the situation on the labour market were significantly positively correlated with the GDP in (IV). The GDP gap during the recession period was positively correlated with the GDP in the recovery period.

The coefficient of determination, R^2, differs between the models. It is high in (III) but low in (IV).

6.3 Discussion

The results show a sharp decline in GDP for all EEA countries during the first two quarters of the pandemic (Figure 25). During Q1 and Q2 2020, the GDP of the member states was between 4 and 16 percentage points lower than expected were it not for the pandemic.

As we expected, most of these variations were correlated with the differences in NPIs and reduction in physical interaction, as shown in (III). The differences in the decrease of labour between the countries was not significantly correlated with the differences in GDP-loss.

The lack of correlation between the differences in the change of labour and the GDP-decline might at first glance seem surprising. As the proportion of people with an occupation fell, a similar reduction in GDP would be expected. The changes in labour were also uncorrelated with the other covariates in our analysis (Figure S.12). The reason might be due to the large amount of governmental support to mitigate the increase in unemployment during the pandemic. The European Commission (51) estimates that the "policy response to the Covid-19 crisis effectively prevented around 1½ million people from being unemployed in 2020[...]" (p. 3). This policy response was partly financed by central EU funding. 98.4 billion EUR were handed out via the so-called "Support to mitigate Unemployment Risks in an Emergency" (SURE) to 19 of the member states. SURE is also assumed by the European Commission to have levelled out the effect on the unemployment between the member states. Therefore, many people might have kept their employments, even if there was no market demand for their labour, particularly in the early phase of the pandemic. The Federal Reserve in the US (52) concludes that "while such policies mitigated staggering unemployment rates towards the beginning of the pandemic in the euro area and the U.K., they also restricted the ability of the economy to adapt through sectoral reallocation."

During the recovery period Q3 2020 - Q3 2022, there was still a positive correlation between physical interaction and GDP (IV). It was however significantly lower than during the recession period, suggesting that behaviour was connected to the extent of the economic decline to a larger extent than the recovery. Contrary to our hypothesis, NPIs did not seem to affect the GDP recovery. This might be explained by a weaker correlation between NPIs and behaviour during the recovery phase, following the vaccinations in the EEA starting in December 2020, as was shown in Figure 19 in section 3 *Behaviour and NPIs*.

Instead, the labour market situation seems to have played a bigger role in the differences in the degree of recovery. The proportion of the work force being able to telework was positively correlated with GDP. This is not surprising considering the increase in the number of people in the EEA teleworking following the pandemic (53). Countries with a lower degree of labour compared to before the pandemic seem to have recovered less from the pandemic. The governmental support to prevent unemployment was, as mentioned, more present during the early phase of the pandemic. This might explain why the labour variable was significantly correlated with the GDP in (IV), even if not being it in (III). These results are line with our expectations.

However, the determination coefficient (R^2 = 0.28) in (IV) suggests that these significant co-variates could merely explain a rather limited proportion of the variation in GDP-gap between the countries and over time. One possible reason might be the differences in governmental policy response over time, for which an accurate quantification is lacking. The potential effect of these policies can thereby be captured by the error term, yielding a low R^2-value. When comparing this value between (III) and (IV), the difference in the length of the periods, two and nine quarters respectively, might also have had an impact.

The mentioned GDP loss in the EEA during 2020 - 2022, 4.8 percent, which was only partly recovered in 2022, can be compared to the US, where The Federal Reserve estimates that there was almost no GDP gap in 2022 (52).

7 Overall discussion

The Covid-19 pandemic caused dramatic changes in the society with an increased mortality, decreased physical interaction, a clear reduction in QALY, and GDP-losses.

We could not establish a significant negative relationship between NPIs and excess mortality. The only relationship we found between these variables was the opposite to the one expected: the countries with more stringent regulations also tended to have higher excess mortality. Imposing stricter NPIs was not a successful measure for reducing mortality during the Covid-19 pandemic. Instead, it is likely that the differences in the degree of NPIs between the countries were driven by the differences in excess mortality: countries that were hit more severely by the pandemic imposed more extensive NPIs in an attempt to reduce the disease spread and thereby the mortality.

One explanation for this unexpected result might be that NPIs, such as closed borders, travel bans, school closures, and workplace closures, may have been effective under ideal conditions, provided a perfect, or at least a high degree of, compliance. However, as has been shown in our analysis, these ideal conditions did not exist in reality on the population level.

People's actual behaviour is crucial and is that which can possibly influence the containment of an infection such as Covid-19.

There is evidence from randomised clinical studies demonstrating a significant reduction in mortality from employees' usage of face masks (54, 55). A Cochrane review by Jefferson et al in 2023 of published clinical evidence on face mask usage in the general population, could not establish this relationship (56). This may also partly be explained by the fact that the Cochran review covered clinical studies not only on Covid-19 but also other types of respiratory viruses. Many studies were conducted during non-epidemic influenza periods. The authors in the review made the interpretation of "its relative effectiveness and the concomitant measures of mask adherence which would be highly relevant to the measurement of effectiveness, especially in the elderly and in young children" (p. 2).

The impact of compliance on effectiveness is well understood in health economic assessments of medical interventions. There are many examples where analysis of real-world data has provided different results than efficacy studies under ideal conditions e.g. in randomised clinical trials. If adherence or compliance are significant problems, expected health benefits demonstrated in RCTs will not appear in real world evidence studies.

Our analysis shows that individuals in the EEA were less compliant with NPIs after the vaccines arrived in 2021. Furthermore, the highlighted Eastern European countries with a high excess mortality also had a low uptake of vaccine in these countries, i.e. there was a lack of vaccination compliance. This low level of PIs, i.e. vaccines, might be one plausible explanation for the relatively higher mortality in these specific countries. The vaccines were distributed equally among the EEA countries based on a central EU agreement. Differences in availability are thus unlikely to be a possible explanation for the low uptake in these Eastern European countries. However, a more plausible explanation is that differences in attitudes towards vaccines between individuals have influenced the uptake, see Popa et al (2022) (31). Here, we see another example of the importance of adherence for real world effectiveness.

The reduction in physical interaction in the EEA during the Covid-19 pandemic was, as mentioned, also correlated with how individuals considered the risk of being infected by the disease and the effects of it. The behaviour of the individuals was thus seemingly not solely a direct reflection of the NPIs implemented by the national authorities and politicians. Their behaviour could also be explained by their perception of the disease risk, which they might have considered to be lower once the majority of the adult population had been fully vaccinated. This may explain why the physical interaction of the individuals gradually reverted to the pre-pandemic behaviour during the second half of 2021, despite the extensive NPIs still in place.

The presented surveys in Sweden and Norway conducted in April 2020 and January 2021 show that the QALY loss in the general population following the behavioural changes and the NPIs during 2020 was substantial. The loss was significantly higher for the single month of April 2020 in both countries than the QALY loss due to the excess mortality during the whole of 2020. In fact, the QALY loss due to excess mortality during all three pandemic years combined, 2020 - 2022, was not significantly higher than the QALY loss during the single months of April 2020 and January 2021 respectively in neither of the countries. In Norway, QALY loss due to excess mortality during the whole of 2020 - 2022 was significantly lower than the QALY loss in the general population during these two single months respectively during which there were substantial NPIs and a decreased physical interaction.

Although Sweden and Norway had the lowest excess mortality in the EEA and also had a lower level of restrictions, it is possible that the QALY loss in the general population could have outweighed the ones due to the mortality in many other EEA countries as well. These results indicate that there is an important tradeoff between implementing safety measures, NPIs, aiming to reduce the mortality among (primarily) elderly and the cost in terms of health related quality of life loss. Considering our results showing that the effectiveness of NPIs on a population level is not to be demonstrated based on real world evidence, caution must be taken before such regulatory interventions are imposed.

These behavioural changes and the NPIs were also strongly correlated with a substantial decline in GDP during the first two quarters of 2020. Even if this correlation was not to be seen to the same degree during the rest of the pandemic, the EEA did not recover from the economic decline it suffered during the first half of 2020. The average decline for the entire region was 4.8 percent of for the whole period of 2020 - 2022, peaking at 7.7 percent during the first year of the pandemic. In 2022, two years after the pandemic outbreak in Europe, all but six countries in the EEA had a GDP lower than expected were it not for the pandemic.

Still, the variation in GDP gap between the EEA countries was considerable: Spain had a gap at 10 percent during 2020 - 2022 as a whole. Czechzia and Romania suffered from a GDP gap at 9 and 8 percent respectively during this entire three-year period. In Norway and Denmark, this gap was at 1 percent.

As mentioned in the introduction, the relationship between income and health has been extensively analysed in economic literature. It is a well-known fact that higher income is associated with better health (57). When the decisions of imposing NPIs were taken, it was also well understood that the introduction of NPIs and the thereby expected changes in behaviour of individuals would reduce economic activity and GDP.

However, in our theoretical framework, we adopted the hypothesis that the interventions during the Covid-19 pandemic could have the opposite effect, i.e. there might be a trade-off between reduced economic activity/income on the one hand and health benefits on the other hand. The result of our analysis did, however, not support this argument. Contrary to this hypothesis, our results confirm the traditional knowledge that health is positively and causally related to income. Our results show that countries that had a higher excess mortality in 2020 in general also had a larger GDP gap during the economic recession in 2020.

One clear example demonstrating this is Sweden, which choose another path at the start of the pandemic with less NPIs. Its GDP did not recover after the pandemic and the country did suffer from substantial QALY losses. There were, however, other EEA countries with a larger GDP gap and, as mentioned, it is also to be assumed that the QALY losses might have been higher in countries with a substantial higher degree of NPIs. These results are in line with our framework, the NPIs and behavioural changes came at a cost in resources and psychological well-being.

Sweden did however also have the lowest excess mortality in the whole EEA - which is contrary to the hypothesis presented in our framework. As mentioned, we are able to connect the NPIs and behavioural changes during the pandemic with substantial costs but are nevertheless unable to prove their benefits in terms of a reduction in the excess mortality. Instead, it seems that a higher degree of excess mortality was initally, to some extent, correlated with a higher level of NPIs.

However, it should also be noted that for the Eastern European countries with the highest excess mortality and a relative low uptake of Covid-19 vaccine, there seems to be an opposite relationship between GDP and excess mortality, at least in 2021. This might indicate that for these countries, the hypothesis may hold to some extent. That is, the existence of a trade-off between reducing physical interactions and economic activities on the one hand and a benefit in terms of lower excess mortality on the other hand.

8 Conclusions

The generally established relationship between health and income is not to be falsified by our research. The relationship between income and productivity on the one hand and health gain on the other hand may exist for effective interventions, but is not to be established for the generally imposed NPIs during the Covid-19 pandemic. What is however to be seen is that the countries in Eastern Europe with the highest excess mortality had a substantial lower degree of PIs, proportion of their populations vaccinated than other EEA countries.

The health and economic costs shown in this report enlighten the need for PIs, i.e. vaccines, as an effective intervention to contain a pandemic. A rapid development of vaccines with a high uptake among the population can increase the physical interaction and thereby potentially save substantial economic sums and mental health. To justify the costs of imposing extensive NPIs and the following behavioural changes as a public health policy during future pandemic, clear health benefits have to be demonstrated as a result of these interventions.

References

1. WHO. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020; 2020. Available from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.
2. Ioannidis JPA. Global perspective of COVID-19 epidemiology for a full-cycle pandemic. European Journal of Clinical Investigation. 2020;50(12):e13423. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/eci.13423.
3. Ferguson NM, Laydon D, Nedjati-Gilani G, Imai N, Ainslie K, Baguelin M, et al. Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College London; 2020. Report 9. Imperial College COVID-19 Response Team. Available from: https://doi.org/10.25561/77482.
4. Jonung L. Sweden's Constitution Decides Its Covid-19 Exceptionalism. Lund University, Department of Economics; 2020. 2020:11.
5. Andersson FNG, Jonung L. The Covid-19 lesson from Sweden: Don't lock down. Economic Affairs. 2024;44(1):3-16. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/ecaf.12611.
6. Kermack WO, McKendrick AG. A Contribution to the Mathematical Theory of Epidemics. Proceedings of the Royal Society of London Series A I. 1927;115:700-21.
7. Boumans M. Flattening the curve is flattening the complexity of covid-19. History and philosophy of the life sciences. 2021 Feb;43:18.
8. Herby J, Jonung L, Hanke SH. A Systematic Literature Review and Meta-Analysis of the Effects of Lockdowns on COVID-19 Mortality II. medRxiv. 2023. Available from: https://www.medrxiv.org/content/early/2023/09/05/2023.08.30.23294845.
9. Islam MS, Sarkar T, Khan S, Kamal AH, Mohammad S, Hasan SMM, et al. COVID-19-Related Infodemic and Its Impact on Public Health: A Global Social Media Analysis. The American journal of tropical medicine and hygiene. 2020 08;103:1-9.
10. Hsiang S, Allen D, Bell K, Bolliger I, Annan-Phan S, Chong TCS, et al.. The Effect of Large-Scale Anti-Contagion Policies on the Coronavirus (COVID-19) Pandemic; 2020.
11. Mackenbach JP, Meerding WJ, Kunst AE. Socioeconomic inequalities in health status and in access to health care; 2007. Available from: https://ec.europa.eu/health/ph_determinants/socio_economics/documents/socioeco_inequalities_en.pdf.
12. Preston SH. The Changing Relation between Mortality and level of Economic Development. Population Studies. 1975;29(2):231-48. PMID: 11630494. Available from: https://www.tandfonline.com/doi/abs/10.1080/00324728.1975.10410201.
13. Mackenbach JP. The persistence of health inequalities in modern welfare states: The explanation of a paradox. Social Science & Medicine. 2012;75(4):761-9. Part Special Issue: Challenges to changing health behaviours in developing countries. Available from: https://www.sciencedirect.com/science/article/pii/S0277953612002055.
14. Our World in Data. Life expectancy vs. GDP per capita; 2023. Available from: https://ourworldindata.org/grapher/life-expectancy-un-vs-gdp-per-capita-wb?xScale=linear.

15. Becker GS, Philipson TJ, Soares RR. The Quantity and Quality of Life and the Evolution of World Inequality. National Bureau of Economic Research; 2003. 9765. Available from: http://www.nber.org/papers/w9765.

16. Persson U, Norinder A, Hjalte K, Gralén K. The value of a statistical life in transport: findings from a new contingent valuation study in Sweden. Journal of Risk and Uncertainty. 2001;23:121-34.

17. Persson U, Norinder AL, Svensson M. In: Schwab Christe NG, Soguel NC, editors. Valuing the Benefits of Reducing the Risk of Non-Fatal Road Injuries: The Swedish Experience. Dordrecht: Springer Netherlands; 1995. p. 63-83. Available from: https://doi.org/10.1007/978-94-011-0665-8_4.

18. Ruhm CJ. Are Recessions Good for Your Health? The Quarterly Journal of Economics. 2000 05;115(2):617-50. Available from: https://doi.org/10.1162/003355300554872.

19. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. The Lancet. 2009;374(9686):315-23. Available from: https://www.sciencedirect.com/science/article/pii/S0140673609611247.

20. Ruhm CJ. Recessions, healthy no more? Journal of Health Economics. 2015;42:17-28. Available from: https://www.sciencedirect.com/science/article/pii/S0167629615000326.

21. Karanikolos M, Mladovsky P, Cylus J, Thomson S, Basu S, Stuckler D, et al. Financial crisis, austerity, and health in Europe. The Lancet. 2013;381(9874):1323-31. Available from: https://www.sciencedirect.com/science/article/pii/S0140673613601026.

22. Google. Community Mobility Reports; 2022. Last accessed on 2023-09-22. Available from: https://www.google.com/covid19/mobility/.

23. Hale T, Angrist N, Goldszmidt R, Kira B, Petherick A, Phillips T, et al. A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). Nature human behaviour. 2021 Apr;5:529-38.

24. Eurostat. GDP and main components; 2024. Last accessed on 2024-06-17. Available from: https://ec.europa.eu/eurostat/databrowser/view/NAMQ_10_GDP__custom_10009559/default/table?lang=en.

25. Eurostat. Excess mortality by month; 2024. Last accessed on 2024-02-21. Available from: https://ec.europa.eu/eurostat/databrowser/view/DEMO_MEXRT__custom_1210067/bookmark/table?lang=en&bookmarkId=fc27a3a9-082b-461d-830b-a4c7b36caf4f.

26. Persson U, Olofsson S, Yan Gu N, Gong CL, Jiao X, Hay JW. Quality of Life in the Swedish General Population During COVID-19 - Based on pre- and post-pandemic outbreak measurement. Nordic Journal of Health Economics. 2021;9(1):56-73.

27. Brådvik G, Lindgren P, Persson U. Varför stängde västeuropeiska länder ned olika mycket under 2020? Ekonomisk Debatt. 2022;50(8):54-67.

28. Statistics Sweden. Döda per månad efter region, födelseregion, ålder, kön, månad, tabellinnehåll och år. Stockholm, Sweden; 2024. [Data accessed 2024-08-02 11:34:33 using pxweb R package 0.17.0]. Available from: https://api.scb.se/OV0104/v1/doris/sv/ssd/START/BE/BE0101/BE0101I/DodaManadReg.

29. Andersson FNG. Frivillig anpassning eller tvingande restriktioner? Överdödligheten, pandemibekämpningen och den ekonomiska utvecklingen i Europa under 2020. Statsvetenskaplig tidskrift. 2022;124(2):463-91.

30. European Commission. EU Vaccines Strategy; 2022. Last accessed on 2024-11-27. Available from: https://commission.europa.eu/strategy-and-policy/coronavirus-response/public-health/eu-vaccines-strategy_en.

31. Alina P, Enache A, Popa I, Antoniu S, Dragomir R, Burlacu A. Determinants of the Hesitancy toward COVID-19 Vaccination in Eastern European Countries and the Relationship with Health and Vaccine Literacy: A Literature Review. Vaccines. 2022 04;10:672.

32. Pizzato M, Gerli AG, La Vecchia C, Alicandro G. Impact of COVID-19 on total excess mortality and geographic disparities in Europe, 2020–2023: a spatio-temporal analysis. The Lancet Regional Health – Europe. 2024;44(100996). Available from: https://www.thelancet.com/journals/lanepe/article/PIIS2666-7762(24)00163-7/fulltext.

33. The Economist. Covid-19 is now in 50 countries, and things will get worse. The Economist. 2020. Available from: https://www.economist.com/briefing/2020/02/29/covid-19-is-now-in-50-countries-and-things-will-get-worse.

34. Eurostat. Individuals - devices used to access the internet; 2024. Last accessed on 2024-02-21. https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_dev_i/default/table?lang=en.

35. Google. Covid 19 open data: Weather; 2022. Last accessed on 2023-09-22. Available from: https://github.com/GoogleCloudPlatform/covid-19-open-data/blob/main/docs/table-weather.md.

36. Irfan M, Razzaq A, Suksatan W, Sharif A, Madurai Elavarasan R, Yang C, et al. Asymmetric impact of temperature on COVID-19 spread in India: Evidence from quantile-on-quantile regression approach. Journal of thermal biology. 2022 Feb;104:103101.

37. Eurostat. Population on 1 January; 2024. Last accessed on 2024-02-21. Available from: https://ec.europa.eu/eurostat/databrowser/view/tps00001/default/table.

38. Chen J, Gong CL, Persson U, Gu NY. A cross-country comparison of health-related quality of life in the United States, Sweden, and Norway during the first year of the COVID-19 pandemic. Archives of public health = Archives belges de sante publique. 2023 Apr;81:58.

39. OECD. Teleworking in the COVID-19 Pandemic: Trends and Prospects; 2021. https://ec.europa.eu/eurostat/databrowser/view/tec00001/default/table.

40. Simons G. Swedish Government and Country Image during the International Media Coverage of the Coronavirus Pandemic Strategy: From Bold to Pariah. Journalism and Media. 2020;1(1):41-58. Available from: https://www.mdpi.com/2673-5172/1/1/4.

41. Brådvik G, Augustsson M, Lindgren P, Persson U. Svenskar stannade hemma under pandemin – oavsett regleringar. Läkartidningen. 2024;121:24085. Online publication date: December 5, 2024. Available from: https://lakartidningen.se/halsoekonomi/2024/12/svenskar-stannade-hemma-under-pandemin-oavsett-regleringar/.

42. Lag (2021:4) om särskilda begränsningar för att förhindra spridning av sjukdomen covid-19; 2021. Accessed: 2024-11-27. Svensk författningssamling. Available from: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-20214-om-sarskilda-begransningar-for-att_sfs-2021-4/.

43. Socialdepartementet. Tillfälliga nedstängningar och förbud för att förhindra spridning av sjukdomen covid-19; 2021. Promemoria, S2021/01499. Regeringskansliet. Available from: https://www.regeringen.se/contentassets/9a889a92d3f74169a048fc6aa2338a1f/tillfalliga-nedstangningar-och-forbud-for-att-forhindra-spridning-av-sjukdomen-covid-19.pdf.

44. Briggs AH, Goldstein DA, Kirwin E, Meacock R, Pandya A, Vanness DJ, et al. Estimating (quality-adjusted) life-year losses associated with deaths: With application to COVID-19. Health Economics. 2021;30(3):699-707. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/hec.4208.

45. Garratt A, Hansen T, Augestad L, Rand K, Stavem K. Norwegian population norms for the EQ-5D-5L: results from a general population survey. Quality of Life Research. 2022 02;31:1-10.

46. Statistics Norway. Døde, etter kjønn og 1-årige aldersgrupper 1986-2023. Oslo, Norway; 2024. Last accessed on 2024-09-03. Available from: https://data.ssb.no/api/v0/no/table/10325.

47. Eurostat. Labour market slack by sex and age - quarterly data; 2024. Last accessed on 2024-06-17. Available from: https://ec.europa.eu/eurostat/databrowser/view/lfsi_sla_q/default/table?lang=en&category=labour.employ.lfsi.une.

48. Dingel JI, Neiman B. How many jobs can be done at home? Journal of Public Economics. 2020;189:104235. Available from: https://www.sciencedirect.com/science/article/pii/S0047272720300992.

49. John H, Dragoș A, Elisa S. Recovery from COVID-19: The changing structure of employment in the EU; 2022. Eurofound. Available from: https://www.eurofound.europa.eu/en/publications/2022/recovery-covid-19-changing-structure-employment-eu.

50. Eurostat. Gross domestic product at market prices; 2024. Last accessed on 2024-06-06. Available from: https://ec.europa.eu/eurostat/databrowser/view/tec00001/default/table.

51. Commission E. Report on the European instrument for Temporary Support to mitigate Unemployment Risks in an Emergency (SURE) following the COVID-19 outbreak pursuant to Article 14 of Council Regulation (EU) 2020/672 SURE after its sunset: final bi-annual report. Brussels; 2023. COM(2023) 291 final.

52. FEDS Notes. Why is the U.S. GDP recovering faster than other advanced economies?; 2024. Last accessed on 2024-08-28. Available from: https://www.federalreserve.gov/econres/notes/feds-notes/why-is-the-u-s-gdp-recovering-faster-than-other-advanced-economies-20240517.html.

53. Adascalitei D, vacas soriano C, Staffa E, Hurley J. Telework and teleworkability during COVID: An analysis using LFS data. Eurofound working paper. 2022 07.

54. Chernozhukov V, Kasahara H, Schrimpf P. Causal impact of masks, policies, behavior on early covid-19 pandemic in the U.S. Journal of Econometrics. 2021;220(1):23-62. Pandemic Econometrics. Available from: https://www.sciencedirect.com/science/article/pii/S0304407620303468.

55. Li Y, Liang M, Gao L, Ayaz Ahmed M, Uy JP, Cheng C, et al. Face masks to prevent transmission of COVID-19: A systematic review and meta-analysis. American Journal of Infection Control. 2021 Jul;49(7):900-6. Available from: https://doi.org/10.1016/j.ajic.2020.12.007.

56. Jefferson T, Dooley L, Ferroni E, Al-Ansary L, van Driel M, Bawazeer G, et al. Physical interventions to interrupt or reduce the spread of respiratory viruses. Cochrane Database of Systematic Reviews. 2023;(1). Available from: https://doi.org//10.1002/14651858.CD006207.pub6.

57. Finkelstein A, Persson P, Polyakova M, Shapiro JM. A Taste of Their Own Medicine: Guideline Adherence and Access to Expertise. American Economic Review: Insights. 2022 December;4(4):507–26. Available from: https://www.aeaweb.org/articles?id=10.1257/aeri.20210591.

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