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WELL-BEING ANALYSIS FAVOURS A VIRUS-ELIMINATION STRATEGY FOR COVID-19

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ABSTRACT

A well-being approach requires looking beyond COVID-19 deaths to compare the performance of elimination versus mitigation strategies as measured by other important supports for well-being. What do the data show? Our comparison based on 2020 data shows a virus elimination strategy to be more successful than other options, whether measured in terms of COVID-19 deaths, overall excess deaths, income, unemployment, trust, or mental and physical health. Countries that chose and followed a strategy of reducing community transmission to zero and keeping it there saved lives and better protected income and employment, all without obvious costs to either the social fabric or the mental health of their populations.

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Introduction

How well have different societies managed to preserve the quality of life under COVID-19? Can well-being research help to explain which local and national strategies have been most successful? It is too soon for a definitive judgment, but important to scan the emerging evidence to help guide nations around the world managing the virus and its successors for years to come. For this assembly of evidence, we focus our analysis on a comparison between two quite different national strategies for facing the pandemic, based primarily on data covering the whole of 2020. One group of nations, which we call *Eliminators*, includes about 10% of countries, representing more than 25% of the world's population. They adopted a strategy early in 2020 to suppress community transmission to zero, and to keep it there. The second group, whom we call *Mitigators,* contains most national governments. Countries in this group adopted a variety of strategies, ranging from initial denial to early attempts to 'flatten the curve', in order to preserve the capacity of health care systems to deal with the sick while attempting also to limit the effects of lockdown and other non-pharmaceutical interventions on a whole range of supports for happier lives, including social connections, family life, education and the economy. We shall use 'mitigation' to describe the general strategy of dealing with COVID-19 by some route other than elimination of community transmission, since the generally expressed aim of countries which chose mitigation over elimination was to find some middle ground that avoided over-loading health care systems, limited the direct health toll of the pandemic, and kept the economy and society as open as feasible within those constraints. Although our analysis will mainly compare the results of the elimination strategy to all others, we shall also consider alternative approaches within the larger suppression+mitigation group of countries.

Our analyses show that Eliminators experienced lower death rates from COVID-19. But to what extent were these reductions in COVID-19 deaths obtained at the expense of other aspects of economic and social life, and of the mental and physical health of the general population? To answer this question, we shall compare various aspects of life in the two groups of countries. How should the two groups of countries be defined? In our later analysis based on 154 countries, we find that proximity to SARS deaths and membership in the WHO Western Pacific Region (WHOWPR) were both instrumental in the choice of a virus suppression strategy. Our main analysis will split countries using WHOWPR membership as the way to divide countries

between the elimination and mitigation groups. We have two reasons for using WHOWPR membership as a proxy variable to capture countries committed to virus elimination. The first is that WHOWPR countries had, via their SARS exposure and subsequent policy discussions designed to develop pandemic responses,[1] privileged access to the most helpful scientific information. The second reason, adopted to increase the credibility of our results, is that we want to use some selection criterion that is not determined by actual cases and deaths due to COVID-19. We do not wish to tilt the scales in favour of elimination by simply selecting countries with low death rates. We shall also test the robustness of our conclusions to the use of alternative definitions of membership in the virus elimination group, and test our findings separately for the industrial countries of the Organization for Economic Cooperation and Development (OECD). We shall also consider differences in COVID-19 success, as measured by direct and total excess deaths, among countries and groups of countries within the large number of countries in the mitigation group. Within the OECD country group, we pay special attention to the Nordic countries, which, with the exception of Sweden, achieved much lower death rates than elsewhere in Western Europe.

The well-being approach we adopt in this paper requires us to look beyond COVID-19 deaths to compare the performance of elimination versus mitigation strategies as measured by other important supports for well-being. The World Happiness Reports emphasize the happiness-supporting roles of healthy life expectancy, friends and family, freedom, trust, income, and generosity. COVID-19 and the efforts required to deal with it threatened health, income, and possibly freedom and social connections, while drawing on generosity, support from family and friends, and especially social and institutional trust, to improve and share quality of life.

What do the data show? First there has been a surprisingly wide-spread resilience of life evaluations in the face of deep and uncertain threats to lives and livelihoods. Second, a comparison based on 2020 data shows the virus-suppression strategy to be more successful, whether measured in terms of COVID-19 deaths, overall excess deaths, income, unemployment, trust, or mental and physical health.[2] Eliminators saved lives, better protected the economy and jobs, all without obvious costs to mental health and well-being.

Background

Evidence was forthcoming early in the pandemic that COVID-19 was marked by high transmissibility in its pre-symptomatic phase,[3] transmission by asymptomatic carriers,[4] and transmission channels in which aerosols play a key role.[5] These features, which together counselled widespread testing as the only feasible means to find and eliminate community transmission, were not taken into account in early policy advice, both from the WHO and in most western countries. Policy advice within the WHO and in most western countries instead focussed on strategies that assumed primary transmission was via droplets (hence the two metre physical separation rule, and early recommendations against mask-wearing[6]) and on surfaces (hence the emphasis on hand-washing and cleaning)[7] and, most importantly, implicitly assumed that transmission was entirely via symptomatic carriers (hence the advice to provide testing only for those with symptoms, or with infected close contacts). Assuming that asymptomatic and pre-symptomatic transmission could be ignored led to under-emphasis on the role of testing, while assuming the insignificance of aerosol transmission led to ignoring the importance of masks and exaggerating the value of physical distancing and clean surfaces.

The combination of aerosol transmission and the prevalence of asymptomatic carriers made COVID-19 a particularly stealthy virus. However, the early genetic sequencing of the virus led to the possibility of testing for the virus in its various forms with reasonable speed and high accuracy, thus rendering feasible a strategy to identify and target outbreaks, to isolate those infected, and hence to eliminate community transmission.

Both the stealth of the virus and the scope for testing and targeting to remove it from community transmission were recognized first in countries in the Asia-Pacific region, leading them to be predominant among the countries adopting a virus elimination strategy. Thus, our first comparison of international differences in direct and indirect COVID-19 deaths is on a regional basis. We shall then turn later to a country-based analysis to help understand why some countries adopted differing strategies and achieved better or worse results in terms of several variables important for well-being.

We start by comparing direct and indirect COVID-19 death rates in 2020, based on the 72 countries for which all-cause death rates for 2020 are currently available. For our subsequent comparisons of economic and social outcomes, and for our analysis of death rate differences, we are able to use samples up to 150 or more countries.

Comparing direct COVID-19 deaths with overall excess death rates for 2020

Since COVID-19 has affected all aspects of life, there has been a natural interest in using total excess mortality rather than directly attributed COVID-19 deaths as an overall indicator of the mortality consequences of COVID-19.[8] Total excess deaths could exceed direct deaths for several reasons. Direct deaths could be under-counted, lock-downs or shortages or overstretched hospitals[9] could lead to other conditions being under-treated, or the disruptions to society[10] could increase suicides[11] or other so-called deaths of despair. Total excess deaths could be less than direct COVID deaths if policies used to limit transmission of COVID-19 reduced the death toll from seasonal flu, pneumonia,[12] and other communicable diseases, or if the slower pace of economic activity reduced deaths from traffic fatalities or air pollution.[13] Those who argued for less attention to stopping deaths from COVID-19 in order to save deaths from other causes presumed that excess deaths might be larger than direct deaths in the countries that did most to reduce direct deaths.

Hence it is necessary to look at both direct COVID-19 fatalities and total excess deaths if there is a convincing overall case to be made that virus elimination was the better way to protect public health and well-being. Figures 1 to 3 compare the experience of countries in the Asia Pacific and in Western Europe. This is a useful comparison because most countries with a virus elimination strategy are in the Asia Pacific region, a reflection of policy choices that are likely have been influenced by the region's SARS experience and memberships in the Western Pacific Region of the World Health Organization (WHOWPR). Countries in Western Europe, on the other hand, tended to adopt mitigation or suppression strategies. The countries of Western Europe are themselves divided into three groups. The Nordic countries are singled out for special attention within Europe for several reasons. First, they are all in the top echelon of global life evaluation rankings, supported by levels of social and institutional trust that are also among the highest in the world. It has been shown that countries with high institutional trust are more likely to accept

public health guidelines, and are more likely to look out for each other where social trust is higher. Sweden is singled out among the Nordic countries because it shares the same high levels of social and institutional trust, but public health officials in Sweden chose,[14] with the support of government, to adopt a mitigation strategy, while their Nordic neighbours chose instead to target a much greater degree of virus suppression.

The data shown in Figures 1 to 3 are drawn from the 72 countries for which comparable data are available for direct COVID-19 deaths and all-cause excess mortality covering the whole of 2020. The recorded COVID-19 death rates in 2020 per 100,000 population were retrieved from https://ourworldindata.org/coronavirus-data on January 18, 2021, while the all-cause mortality data are from Karlinsky & Kobak (2021).The biggest difference between this sample, whose size is restricted by the availability of excess death statistics, and our later global analysis is that excess death statistics are almost absent for Africa.[15] There is much fuller coverage of the industrial countries, and of two main regions – North Atlantic and Asia-Pacific – that have had very different COVID-19 strategies. Figure 1 shows the consequences for the Asia Pacific region and Western Europe of their very different strategies, with elimination being the norm in the Asia Pacific region and some combination of periodic suppression and mitigation being the norm in Western Europe. Recorded COVID-19 deaths and total excess deaths are both far higher in Western Europe than in the Asia Pacific region. For the nine Asia Pacific countries[16] with available excess death data, the average direct COVID-19 death rate is almost exactly 1 per 100,000 people, while the overall excess death rate was 11.5 per 100,000. For the 20 countries of Western Europe as a whole, the recorded COVID-19 deaths in 2020 average 65.5 per 100,000, and the overall excess death rate for 2020 was 92.7 per 100,000. Within Western Europe, Sweden can be seen to have a COVID-19 direct death rate slightly higher than in non-Nordic Europe (86 compared to 78), and overall excess deaths significantly lower (89 compared to 111). Within the Nordic countries, despite their shared high levels of social and institutional trust, the different strategies have very large consequences for COVID-19 and total excess deaths. COVID-19 deaths in 2020 averaged 86 in Sweden compared to 12 per 100,000 in the other four Nordic countries, while total excess deaths were 89 in Sweden compared to 23 per 100,000 in the other four Nordic countries.

Figure 1
Comparing COVID deaths in 2020 to total excess deaths for 2020
For Western Europe and the Asia Pacific region

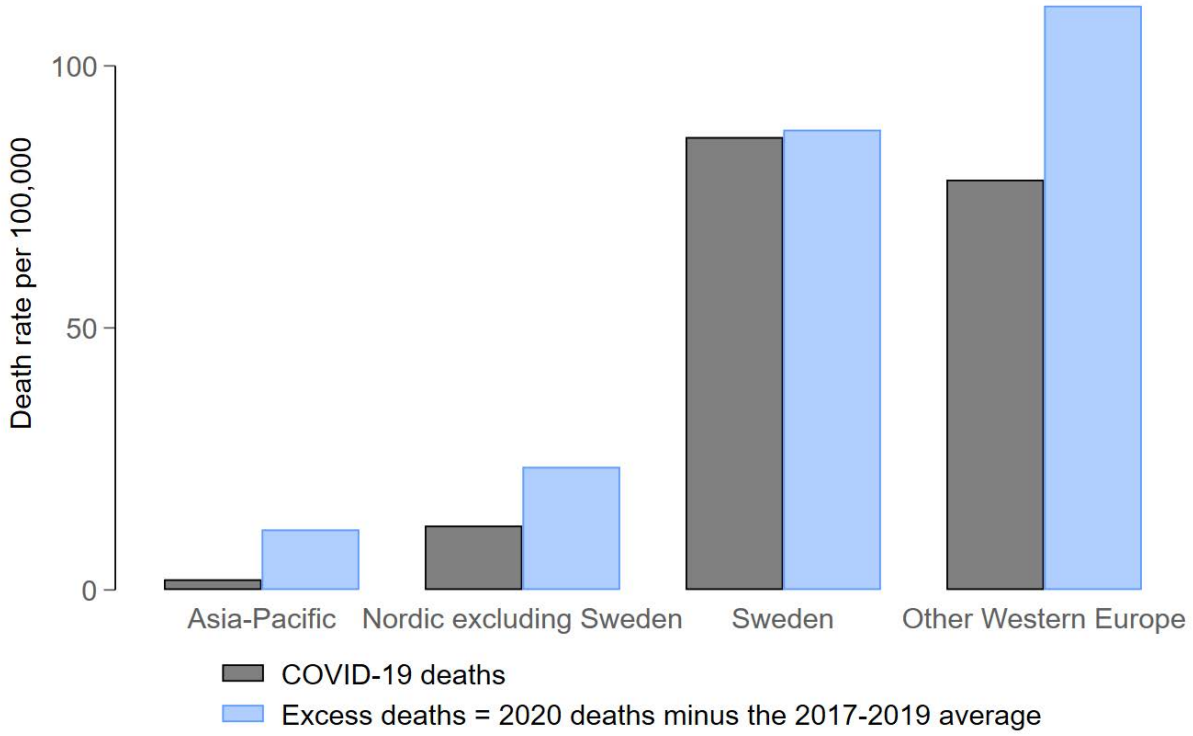


Figure 2 presents the same data for Latin America, the United States, the United Kingdom, and Italy. The data for the Nordic countries excluding Sweden are repeated to show the change in scale required to include these countries and regions. Once again, the data show that countries that were not able or willing to limit COVID-19 direct fatalities had non-COVID excess deaths that were sometimes as large again as recorded deaths from COVID-19. For the ten Latin American countries[17] for which excess deaths are available, the average rate of COVID-19 direct deaths was 80 per 100,000, while for total excess deaths it was 160 per 100,000.

Figure 2
Comparing COVID deaths in 2020 to total excess deaths for 2020
for other regions and countries
Other Nordic repeated to show the change of scale

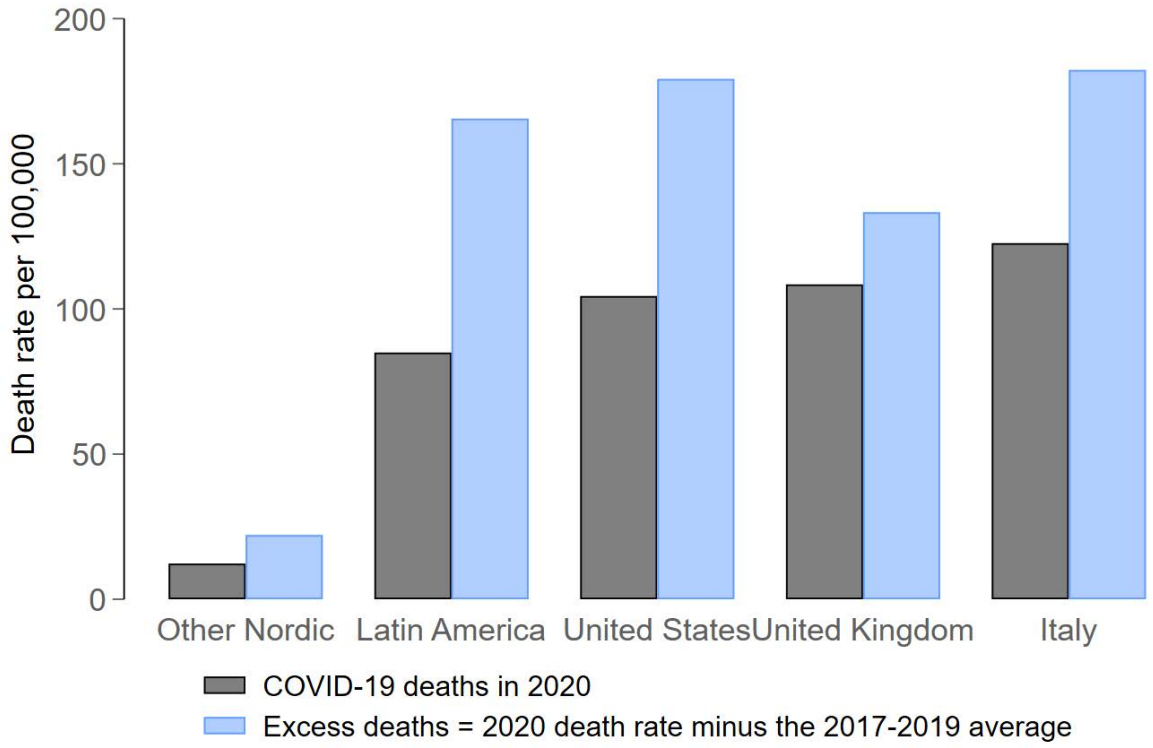
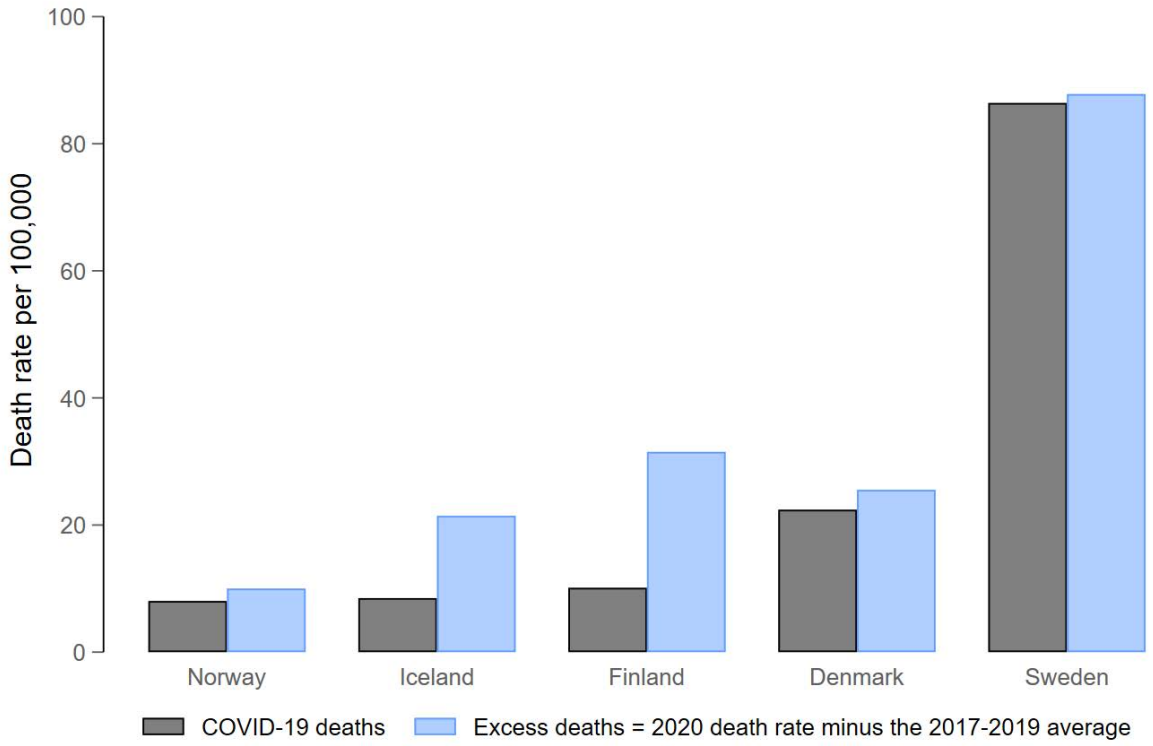


Figure 3 shows the difference in both COVID-19 and all-cause fatalities between Sweden and the other Nordic countries to illustrate that the choice of strategies makes a large difference to health outcomes, even among countries that shared the same disease exposure, high quality health care systems, and high levels of citizen trust of each other and of their institutions.

Figure 3
Differences among Nordic countries in COVID deaths and total excess deaths in 2020



One of the reasons for using excess deaths to supplement recorded COVID-19 deaths is that countries differ in how to allocate deaths where there are comorbidities and other conditions that might have been expected to lead to death. Low estimates of COVID-19 deaths are also likely where many deaths occur outside the hospital system, and where the health care system is overloaded already. Low testing rates will also limit the number of those known to be infected, and whose deaths would therefore be naturally attributed to COVID-19. At one end of this spectrum of possibilities probably lies Sweden, where COVID-19 is taken to be the cause of death anytime that COVID-19 was present, even if the death was likely due to other causes. At the other end of the spectrum would lie countries with poor record-keeping, inadequate hospital systems, and perhaps not anxious to know or reveal the full extent of the disease and its consequences. We attempt in Table 1 to test the nature of the relationship between directly estimated COVID-19 deaths and total excess deaths, of which they naturally form a part, since there were no COVID-19 deaths recorded in the base years 2017-2019. We find a coefficient of 1.48 for the direct deaths, showing that directly attributed COVID-19 deaths are, for the average country, almost one-third less than the total number of excess all-cause deaths in 2020. This

implies that, for most countries, the total number of deaths due to COVID-19 is almost 50% higher than the recorded number for direct COVID-19 deaths. The ratio of excess deaths to directly recorded deaths varies a lot between countries, being below 1.0 for those countries[18] where the measures taken to slow the pandemic also reduced deaths from some other causes, and where health systems were not over-stretched to give timely treatment to other conditions. To estimate possible under-recording of COVID-19 deaths, we include a measure of government accountability, one of the six components[19] of the World Bank's quality of government indicators. This variable attracts a highly significant and sizeable coefficient, such that increasing accountability by one-quarter of its range across the 72 countries is associated with a reduction of excess deaths, of more than 25 per 100,000.

Table 1
Indirect COVID-19 deaths increase more than direct deaths, especially if undercounted

Excess deaths in 2020	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Direct death rate	1.48	.142	10.44	0	1.197	1.763	***
Accountability	-10.641	2.311	-4.61	0	-15.251	-6.031	***
Constant	44.789	9.956	4.50	0	24.927	64.651	***
Mean dependent var		112.477	SD dependent var			79.673	
R-squared		0.626	Number of obs			72	
F-test		57.678	Prob > F			0.000	

**** p<.01, ** p<.05, * p<.1*

Having used the smaller sample of 72 countries to establish that the life-saving benefits of a COVID-19 elimination strategy are about 50% higher when the analysis is couched in terms of excess deaths, our further analysis makes uses of the largest global samples available to assess the effects of alternative COVID-19 strategies on other key variables supporting well-being.

Other determinants of well-being

Here we shall consider income and employment, trust, inequality, physical and mental health, social support, freedom, and prosocial activity. In almost all cases we find that countries which have been most successful at avoiding direct COVID-19 deaths have done as well or better on these other key supports for well-being.

Income and employment

Most countries pursuing a mitigation strategy feared that lockdowns would lead to losses in income and employment. Meanwhile, countries who adopted an elimination strategy believed that that the temporary closures were necessary for removing community transmission of COVID-19, and thereby improve both income and employment in the longer run. The available evidence supports the latter view.

Table 2 shows that countries which kept COVID-19 deaths in 2020 low were also able to achieve higher levels of economic activity in 2020. The sample of 148 countries is the largest for which direct COVID-19 deaths and estimates of 2020 GDP are available. Recent updates to the GDP estimates for 2020 have made the relationship even stronger[20] than it was shown to be in *World Happiness Report 2021.* As shown in Table 2, each drop of 10 COVID-19 deaths per 100,000 population is associated with 2020 GDP 0.5% higher.

Some previous well-being evaluations[21] of alternative COVID-19 policies focused on the choice of a best date for ending lock-downs, and making use of the key assumption that an earlier end to the lock-down would cost lives but increase GDP. This is analogous to macroeconomic analysis assessing how alternative fiscal policies might face a Phillips curve trade-off between inflation and unemployment. In Table 2 we are in essence estimating whether alternative COVID-19 strategies faced a similar trade-off between fatalities and GDP growth.

Table 2
2020 real GDP 1% less for every increase in COVID-19 deaths by 20 per 100, 000 people

GDP2020	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Death rate	-.053	.008	-6.46	0	-.069	-.037	***
Constant	-1.759	.415	-4.24	0	-2.579	-.939	***

Mean dependent var	-3.472	SD dependent var	4.388
R-squared	0.222	Number of obs	148
F-test	41.769	Prob > F	0.000

*** *p<.01,* ** *p<.05,* * *p<.1.* Death rate refers to the number of COVID-19 deaths reported per 100,000 as of December 31, 2020.

The correlation suggests that eliminator countries faced no such trade-off, since they were

able to achieve their much lower death rates while also doing better in terms of income and employment. If we look at the average estimated 2020 and forecast 2021 GDP growth rates for the two groups of countries, average declines in GDP from 2019 to 2020 were 1.45% in the WHOWPR countries, compared to 3.4% in the mitigation countries. A similar growth advantage for the elimination strategy continues into 2021, where GDP growth is forecasted by the World Bank to average 4.7% in the virus elimination group and 2.9% in the mitigation countries.

Virus elimination had similar benefits for employment. The unemployment rate equation in Table 3 shows that countries adopting a COVID-19 elimination strategy in 2020 had unemployment rates that were lower than elsewhere by an average of 5%. The equation also shows that the higher growth rates documented in Table 2 had further impacts on the unemployment rate, as did differences in COVID-19 death rates. Our aim here is to see whether countries choosing mitigation instead of elimination were able to achieve higher income and employment that might in well-being terms have helped to offset the extra loss of life implied by a mitigation strategy. The evidence in Table 3 confirms that there was no such trade-off for either income or unemployment. Eliminators had employment outcomes even better than implied by their higher GDP.

Table 3

2020 unemployment rate lower in countries with COVID elimination strategies

Unemployment rate	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Death rate	-.038	.011	-3.51	.001	-.059	-.016	***
GDP 2020	-.256	.103	-2.48	.015	-.461	-.051	**
WHOWPR	-5.772	1.341	-4.31	0	-8.431	-3.114	***
Constant	9.195	.679	13.54	0	7.849	10.542	***

Mean dependent var	8.406	SD dependent var	4.452
R-squared	0.210	Number of obs	108
F-test	9.205	Prob > F	0.000

*** *p<.01*, ** *p<.05*, * *p<.1*. Death rate refers cumulative COVID-19 deaths reported per 100,000 population as of December 31, 2020. WHOWPR refers to membership in the WHO Western Pacific Region.

Trust

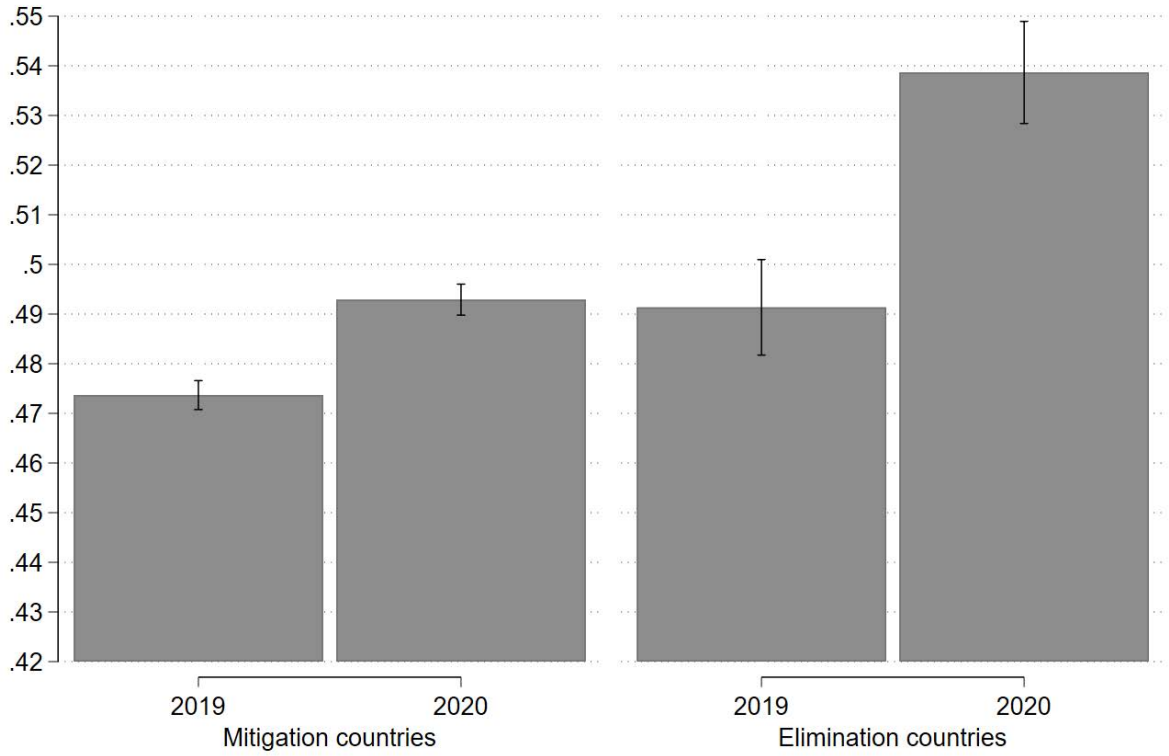
Interpersonal and institutional trust have long been shown to support subjective well-being and facilitate effective community response[22] to crises of many sorts, including earthquakes,[23]

storms, tsunamis,[24] financial collapse, and COVID-19.[25] Thus, it is to be expected that high trust levels should have facilitated effective responses to COVID-19, as we shall show subsequently to be the case. In this section we ask whether confidence in national governments increased or decreased differentially for countries which adopted elimination or mitigation strategies[26].

Figure 4 shows that confidence in the national government (Gallup WP139) rose on average from 2019 to 2020 in both elimination and mitigation groups. However, the increase in confidence was much larger in in the elimination countries (from 49.1% to 53.9%) than in the mitigation countries, as represented here by WHOWPR membership (from 47.4% to 49.0%).

Figure 4

Confidence in government increased in elimination countries more than elsewhere

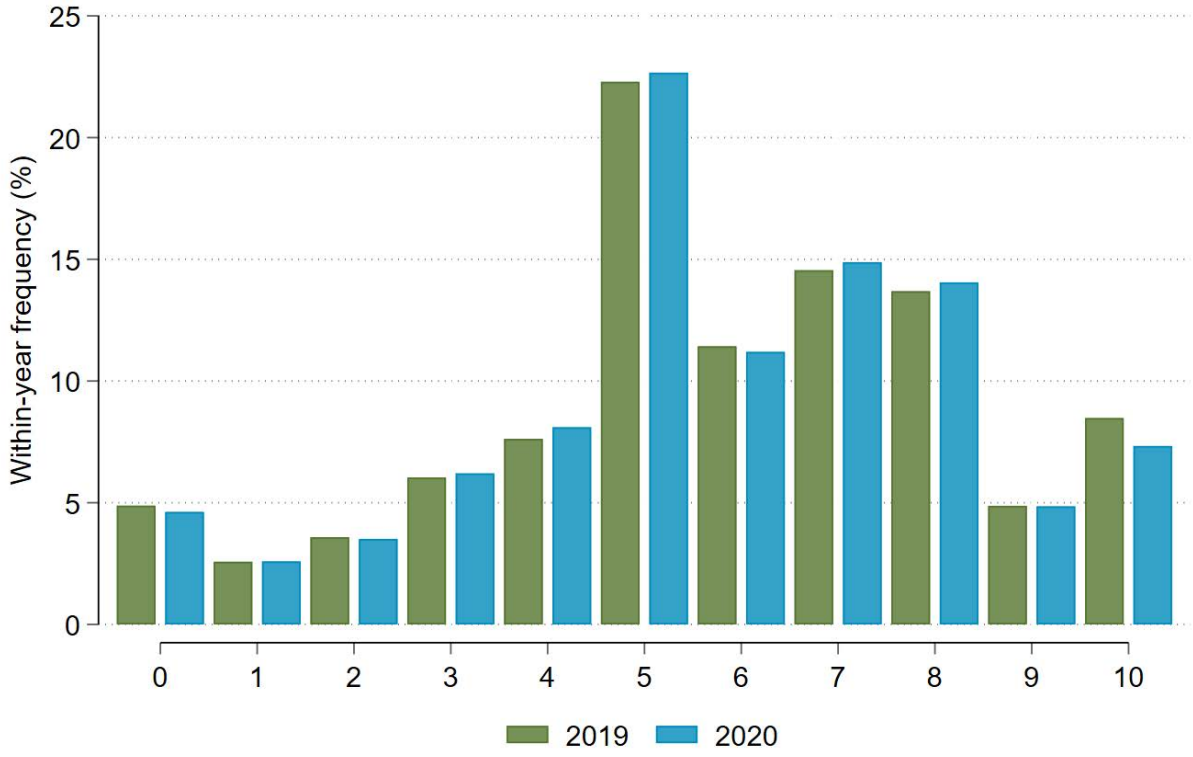


Inequality

It has been shown elsewhere[27] that people are happier living in countries where well-being inequality is less. To what extent has well-being inequality been increased under COVID-19? It has been argued that those already in better circumstances have been favoured even more under COVID-19, while those is less favoured groups have borne the brunt of the well-being losses. This would lead us to expect greater inequality of well-being outcomes. The Gallup World Poll samples are not able to capture the well-being losses of those in elder care, hospitals, living on the streets or in prisons. Subject to that important qualification, the data in Figure 5, which are based on Gallup World Poll data for 112 countries with surveys held in both years show that the distribution of life evaluations over the 11-point response has not only the same mean but also the same distribution in 2019 and 2020. We have also confirmed that this was equally the case for various country groups we consider in this and later sections.

Figure 5

Distribution of life evaluations did not change from 2019 to 2020

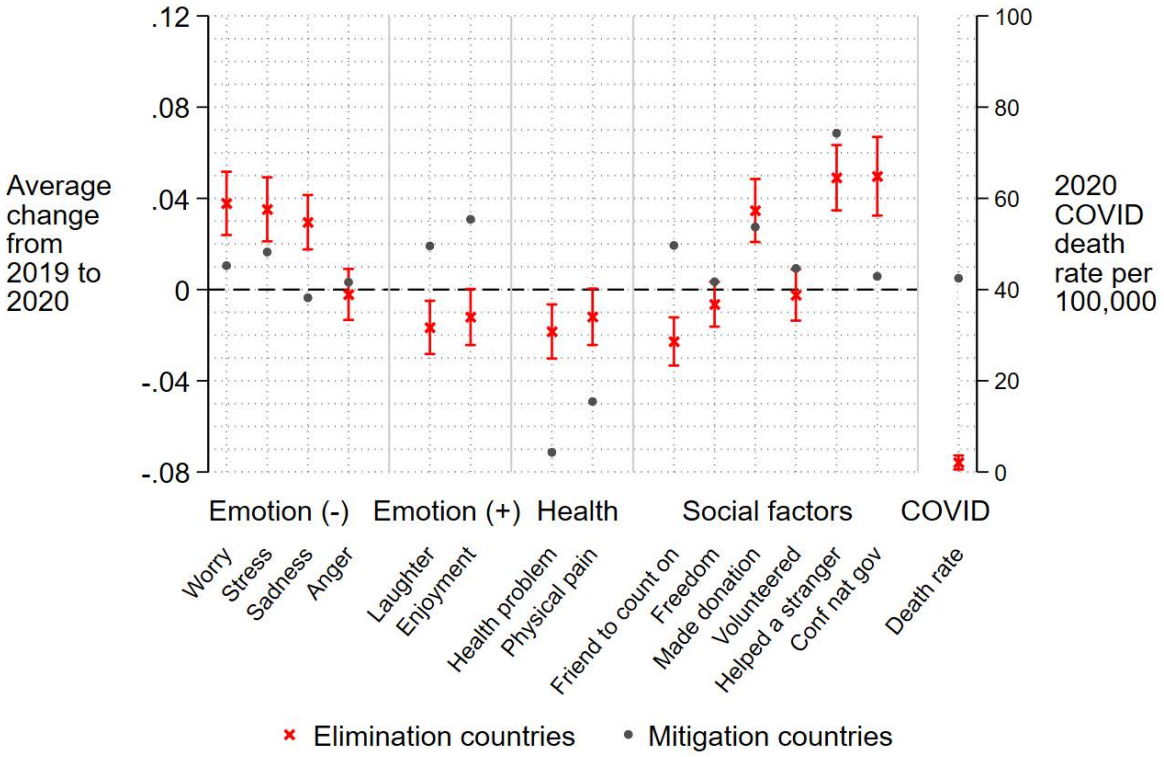


As between men and women, the distributions are also very similar, with women having a 2020 average life evaluation 0.13 above men, and having 2.1 percentage points more responses in the 8 to 10 range, and 1.6 percentage points fewer in the 0 to 3 range. If we compare life evaluations in 2017-2019 with those in 2020 for the 114 countries with surveys in 2020 and in one of the years 2017-19, the average was unchanged, at 5.75. There was a slight but significant increase in the elimination countries, (+.066, p==.04) and an insignificant reduction in the other countries (-.009, p=0.52).

Figure 6 sets the stage for the rest of this section by comparing the average values for the changes from 2019 to 2020 for the variables to be considered below. The vertical lines passing through the eliminator values are the 95% confidence intervals for each estimate. The confidence regions for the elimination countries are on average twice as great as for the mitigation countries, reflecting the much smaller sample size. Both groups of countries show increases in confidence in government, more so in the case of eliminators as we have seen earlier. The two groups also saw reductions in reports of health problems and physical pain, increases in worry stress and sadness, and smaller changes otherwise, except for the helping of strangers, where the increase was large. We will have more detailed comparison between eliminators and mitigators in the remainder of the section. But it is worthwhile to summarize here that the directions of movements are almost always the same for the two groups. There is no obvious evidence that eliminator countries fared much worse than mitigators, despite the sometimes stricter policies used to achieve the elimination objective.

Figure 6

Changes in well-being factors from 2019 to 2020, comparing elimination and mitigation countries



Sources: Gallup World Poll (Worry: WP69, Stress: WP71, Sadness: WP70, Anger: WP74, Laughter: WP63, Enjoyment: WP67, Health problem: WP23, Physical pain: WP68, Friend to count on: WP27, Freedom: WP134, Donation: WP108, Volunteered: WP109, Helped stranger: WP110, Confidence in national government: WP139)

Physical and mental health

For general physical health there is in the Gallup World Poll a question asking whether or not a respondent has health problems, with yes or no being the available answers. For the global sample as a whole, the percentage of the population reporting a health problem fell from 24.6% to 21.6%, with the drop being smaller in the elimination countries (from 21.9% to 19.9%) than in the mitigation countries (from 24.9% to 21.8%).[28] The results for reported prevalence of physical pain the previous day show a similar pattern, falling by slightly less in the elimination countries (down from 22.6% to 21.1%) than in the mitigation countries (down from 33.4% to 31.5%). All of these changes are likely to be related to the prevalence of COVID-19 in the community, with

other possible health problems seeming less worth mentioning where COVID-19 cases and deaths are greater. The prevalence of physical taxing jobs may have been reduced in all countries, presumably moreso in the mitigation countries, given their larger reductions in employment. There are also likely to be changes from 2019 to 2020 in the incidence of non-COVID illnesses (such as the seasonal flu) and in the extent to which other health problems, including cancers and mental illness, were diagnosed and treated. The consequences of delayed diagnosis and treatment are likely to be more evident in 2021 and beyond.

What about emotions? Here the results differ by emotion.[29] In general, as was true for the slightly smaller global samples used in *World Happiness Report 2021,* negative emotions increased under COVID-19. The prevalence of worry increased in both groups of countries, up from 31.9% to 36.0% in the virus elimination countries, and from 39.9% to 43.0% in the mitigation countries. Stress went up more in the virus elimination countries (from 33.2% to 37.1%) than in the other countries (36.9% to 38.9%), while sadness went up by about the same amount in the elimination countries (18.7% to 21.8%) as in the mitigation countries (24.8% to 27.7%). The prevalence of feelings of anger on the previous day remained the same in the elimination countries (18.5 %) while rising in the mitigation countries (20.1% to 20.8%). This result for anger may be related to what was found earlier for confidence in government, which rose significantly in the elimination countries and less so elsewhere.

Positive emotions, which are generally two to three times as prevalent as negative ones, fared slightly better in the mitigation countries. Laughter, usually more prevalent in the elimination countries, fell by the same amount (from 79.8% to 78.0%) as in the mitigation countries (73.6% to 72.8%). Enjoyment fell in the elimination countries (from 76.3% to 74.8%) while being maintained in the mitigation countries (rising insignificantly, from 69.4% to 69.6%).

Social Support

The primary social support variable used in the World Happiness Reports to gauge personal social support is whether the respondent has someone to count on in times of trouble. This fell in both groups of countries, by more in the elimination countries (from 85.3% to 82.8%) than in the mitigation countries (from 83.5% to 82.5%).

Freedom to choose what one does with one's life

This also is measured on a yes/no basis, and fell in the elimination countries (from 85.9% to 85.3%). In the mitigation countries, it remained substantially unchanged (rising from 79.6% to 79.8%).

Prosocial Activity

There are three Gallup World Poll questions, asking, yes or no, if the individual engaged in pro-social acts during the previous month. The question is asked separately for making a donation, volunteering, and helping a stranger. The frequency of donations rose slightly more in the elimination countries (from 32.9% to 34.8%) than in the mitigation countries (from 29.5% to 31.0%). Volunteering was unchanged in the elimination countries (at 19.4%) and nearly unchanged (from 18.6% to 18.8%) in the mitigation countries.

The biggest change was in the frequency of helping strangers, up by about 6% in both groups of countries, starting from a higher base in the mitigation countries. For the elimination countries, the increase was from 39.8% to 45.5%, while for the mitigation countries the frequency of positive responses rose from 50.4% to 56.0%. There is also evidence of increased helping of neighbours during COVID-19 (Zetterberg et al. 2021). Willingness to help others in a time of emergency has been documented earlier in cases of fires and accidents, and no doubt increases the subjective well-being of helpers and helped alike, as illustrated by previous research showing that people are far happier if they believe that their lost wallet would be returned if found by neighbours, strangers, or police (Helliwell et al. 2018).

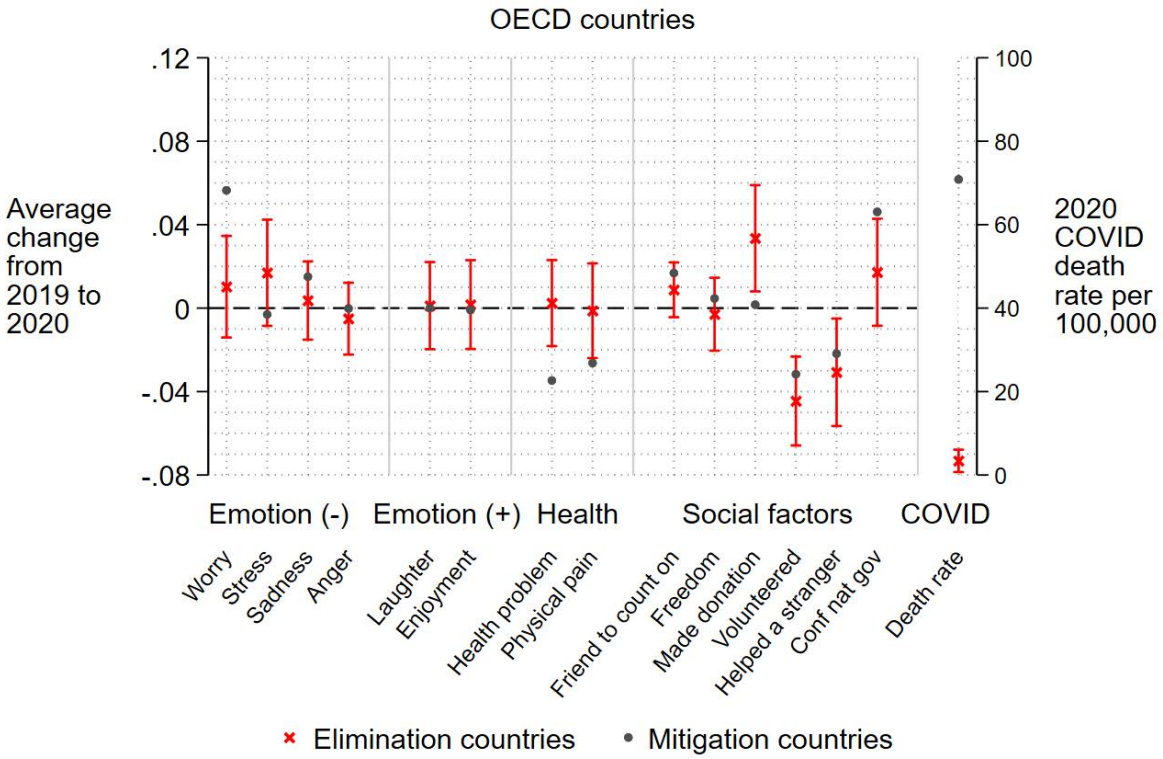
Testing alternative country groupings

One test of the robustness of our findings is to see if they apply when the comparison group of countries is restricted to include countries with somewhat comparable capacities to deal with a health crisis. Because of their criteria for admitting new members, the OECD countries all have democratic political structures, relatively high levels of income and education, and are committed to providing open and trustworthy governance. To match earlier work[30] that

compared the performance of eliminators and mitigators within the OECD, we treat Iceland as an eliminator country. Within the OECD group shown in Figure 7, the eliminator group thus includes Japan, South Korea, Australia, New Zealand and Iceland. The four eliminator countries had average COVID-19 death rates in 2020 of 3.5 per 100,000 people, compared to 70.1 for the rest of the 34 OECD countries. Total excess deaths were 16.1 per 100,000 in the four OECD eliminator countries, compared to 115.2 in the 28 other OECD countries with available data on excess deaths. Confidence in the national government grew from 2019 to 2020 in both groups of OECD countries, most of which were surveyed in the first half of 2020. The increase was greater in the non-elimination countries. The reported frequency of health problems fell most in the non-elimination countries. For worry, sadness, anger, laughter and enjoyment the eliminator countries fared better than the rest, while donations were higher and volunteering and helping strangers less frequent in the eliminators.

Figure 7A

Changes from 2019 to 2020 for OECD countries

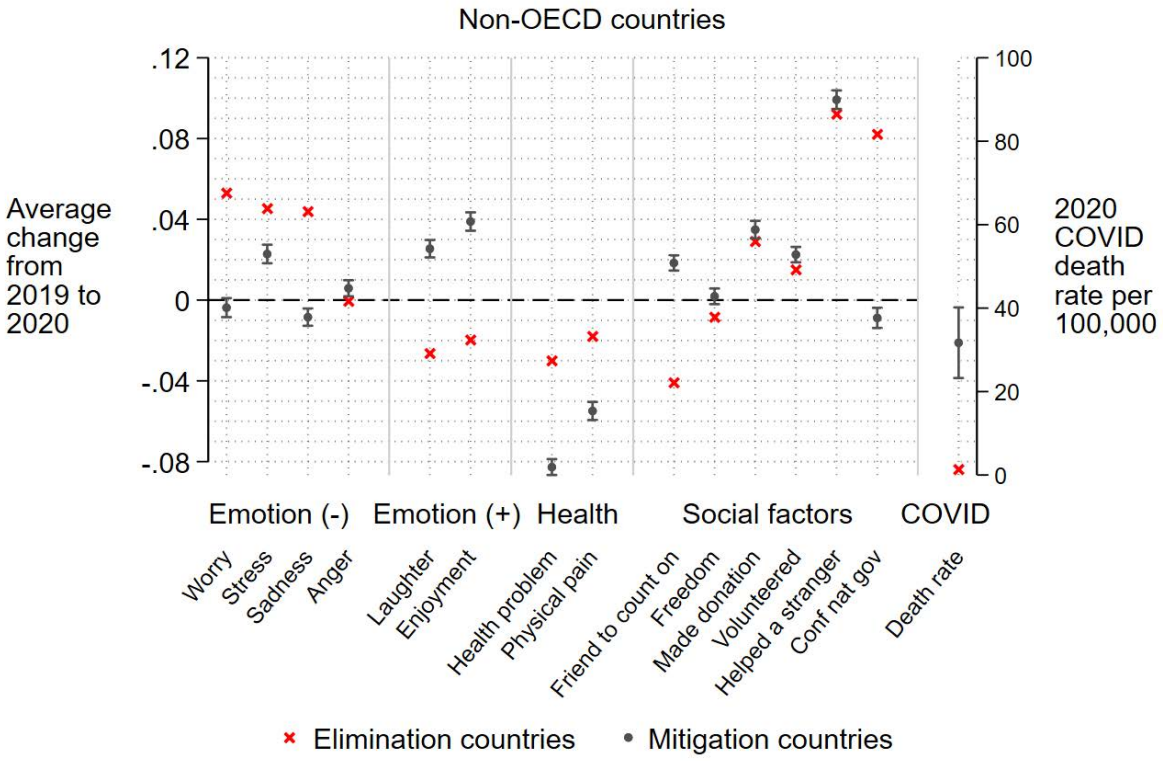


Sources as in Figure 6.

Within the non-OECD countries shown in Figure 7B, we would have added Bhutan and Rwanda as committed eliminators, but they do not have the required Gallup World Poll data for 2019 and 2020. Within the 129 non-OECD countries, the COVID-9 death rate in 2020 was 0.9 in the 13 elimination countries, compared to 24.8 for the other countries. For the more limited number of non-OECD countries where excess deaths data are available, they averaged 11.0 for the 6 eliminators compared to 139.4 for the 34 other countries. Confidence in government fared better in the elimination countries, while emotions fared worse. Many of the non-OECD countries, especially the 41 in sub-Saharan Africa, had favourable age distributions and low exposure, and an average 2020 death rate of only 4.4 per 100,000. The global result of more help to strangers is mostly evident in the non-OECD countries, almost equally evident in both the elimination and other countries.

Figure 7B

Changes from 2019 to 2020 for non-OECD countries



Sources as in Figure 6.

Summary of well-being outcomes beyond direct and indirect deaths from COVID-19

In this section we have looked for evidence that the lower COVID-19 death rates in the elimination group of countries were not offset by worse performance in other aspects of life. For income and employment, which were often used in mitigation countries as reasons to open their economies before community transmission of the virus had been fully eliminated, the evidence seems clear that there was no trade-off between virus elimination and economic activity. Indeed, actual 2020 and expected 2021 economic growth were *higher* in the elimination than in the mitigation countries. Furthermore, unemployment rates in 2020 were lower where COVID-19 death rates were lower and real GDP higher.

Confidence in government rose on average from 2019 to 2020 in both groups of countries, by twice as much in the elimination countries as in the mitigation countries. For most other supports for well-being, the changes were of roughly the same size and direction in both groups of counties. Non-COVID-19 physical health was reported to be better by respondents in both groups of countries. Negative emotions were more prevalent in 2020 in both groups of countries, and positive emotions slightly less prevalent. Among prosocial activities, the biggest change was in the frequency of helping strangers, which increased by about 6% in both groups of countries.

The lack of significant well-being harms from the COVID-19 elimination strategy, combined with its greater effectiveness at preventing deaths, strongly suggests an overall well-being advantage for the elimination strategy. Most mitigation strategy countries chose to re-open before community transmission was eliminated, thereby inviting second and third waves of infection that were in many if not most countries worse than the first wave. Furthermore, the resulting widespread community prevalence of the virus provided an effective petri dish for the creation of new variants that were more transmissible, thereby substantially increasing the global costs of failing to eliminate the virus.

Given our findings, and the availability early in 2020, if not before, of evidence showing the advantages of virus suppression, it remains a puzzle why so many countries were slow to

recognize the necessity of fast and widespread testing to find and suppress a virus that was being spread silently by aerosol transmission from pre-symptomatic and asymptomatic carriers. As a first step in answering this puzzle, we turn in the next section to see what can be done to explain differences among countries in their choice and application of COVID-19 strategies.

What helped countries find and choose an effective COVID-19 strategy?

Here we shift our focus from a binary comparison of country groupings to a more general analysis using 2020 data from 154 countries to help explain the choice of alternative COVID-19 strategies, where success is measured by COVID-19 death rates in 2020 per 100,000 population. Our modelling accounts for about two-thirds of the international differences in 2020 COVID-19 death rates using eight variables, three relating primarily to differences in risk factors, and five to the likelihood of a country choosing and successfully applying policies to reduce COVID-19 death rates.

The three risk factors relate to geography, demography, and early virus exposure. The purely geographic variable is an indicator variable taking the value 1.0 for each of the 14 island nations, and zero elsewhere.[31] COVID-19 deaths per capita in 2020 were on average half as great in the island nations as in other countries. In the multivariate equation, the partial effect of being an island nation is 15.4 deaths per 100,000 population in 2020.

The demographic variable is an age adjustment index based on the interaction of each country's population age profile with age-specific COVID-19 mortality rates drawn from US experience in 2020. The authors refer to this adjustment as 'indirect' because it uses the age-specific mortality experience of the United States as a proxy variable in other countries without available age-specific COVID-19 mortality data. They produce age-adjusted mortality rates for each country, which we convert to a pure mortality risk index by removing each country's own COVID-19 mortality experience. The resulting age adjustment shows the extent to which each country's differential age distribution affects its risk of COVID-19 mortality. We use the age adjustment index in the form where higher values denote younger populations, and hence lower expected

mortality. The ratio takes the value of 1.0 in the United States, since its population structure is the one used as the basis for comparison. Countries whose age structures imply greater risk from COVID-19—older populations such as in Europe and East Asia—have factors less than 1.0. Countries with younger populations have age adjustment ratios greater than 1, with the extreme being six African countries with factors above 6.0. COVID-19 death rates in 2020 averaged 55 per 100,000 population for the 70 countries where the age-adjustment is less than 2.0 compared to 12.5 for the 93 countries with higher ratios. In the Table 4 equation, an increase of 1.0 in the age adjustment index is associated with a reduction of 10 COVID-19 deaths per 100,000.[32]

The exposure variable is more complicated. It uses a gravity approach to measure each country's exposure to cumulative cases in each other country on March 31, 2020. The exposure variable divides the number of cases in each other country by the distance[33] between the capitals of the two countries, and then sums across other countries to get a weighted exposure index for each country, entering the equation in log form, as usual in previous applications of the gravity model in epidemics,[34] trade,[35] migration,[36] and knowledge transfer.[37] The exposure index in log form covers a range from 0.4 to 5.3, being over 4.0 in 8 countries, all of which are in Europe. By continent, it is lowest in sub-Saharan Africa, where it averages 0.85. COVID-19 death rates in 2020 averaged 18.6 per 100,000 in countries with exposure values below 2.0 compared to 66.5 per 100,000 in the 43 countries with exposure values above 2.0. In the multivariate equation shown in Table 4, an increase of 1.0 in the log of the exposure index is estimated to increase COVID-19 deaths by about 16 per 100,000.

Of the three risk variables, the geographic and demographic variables reflect conditions over which government strategies had no control, while the exposure variable reflects primarily the fact that governments in Europe did not adopt an elimination strategy. For individual European countries to adopt such a strategy was for most rendered more difficult by the Schengen agreement providing formality-free population movements among the member countries.

Turning to the variables that help to explain the choice of a death-reducing policy strategy, the first is an indicator variable taking the value of 1.0 for each of the 23 countries with female leaders.[38] Of these 23 leaders, 3 were in the elimination group of countries. COVID-19 death

rates averaged 20 per 100,000 in the countries with female leaders, compared to 32 in other countries. When added to the equation in Table 4, having a female leader is associated with a COVID-19 death rate that is lower by 20 per 100,000.

The next variable captures membership in the WHOWPR group of countries that we have used already to define the group of governments committed to an elimination strategy. COVID-19 deaths per 100,000 in 2020 averaged 1.5 in the WHOWPR compared to 33.4 per 100,00 in the 149 other countries with matching death data. A related variable is the average log distance between each country and the six countries with the highest death tolls in the SARS epidemic of 2003. Five of those countries are also among the members of the WHOWPR group. SARS experience was an important source of learning about the need for rapid response, and the perils of underestimating its transmissibility. The WHOWPR provided an important forum for collecting the lessons learned, and preparing procedures to facilitate virus elimination.[39] Because these two variables are quite highly correlated (r=+.55) their separate coefficients in the equation are not highly significant. Together, they provide a highly significant measure of the possible spread of scientific knowledge that would aid the choice of an elimination strategy. A variable that simply subtracts the WHOWPR indicator from the SARS distance variable, as suggested by the equality of their separately estimated coefficients, attracts a highly significant coefficient of 11.5 (p=.009).

The next variable is a measure of institutional trust based on Gallup World Poll questions relating to confidence in the national government, the judicial system, local police, elections, and the absence of corruption in business.[40] Based on surveys from 2017 through 2019, the index has an average value of 0.422 in the elimination countries, and 0.307 elsewhere. The difference between these two averages is estimated in the equation to correspond to a difference in COVID-19 death rates of 5 per 100,000 people.

Income inequality has previously been found to be associated with worse health status,[41] and is negatively correlated with social trust,[42] which itself has been shown to improve disaster responses.[43] Since we do not have a direct measure of social trust for this large sample of countries, we use the gini index of income inequality to reflect the difficulties of achieving co-

operative outcomes during the pandemic, plus any direct health impacts of income inequality. The gini index has the same average value in the elimination and mitigation countries, so its impact shows up in explaining death rate differences within the mitigation group, which covers a large range of death rates. The gini index of income inequality averages 26 in the Nordic countries and 47.5 in the United States, a difference associated (using the coefficient of 0. 964 in Table 4) with Nordic per capita death rates from COVID-19 to be lower than those in the United States by 20.7 per 100,000 people.

Table 4

COVID deaths explained by geography, demography, exposure, leadership, science, trust, and inequality

Death rate in 2020	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Island	-16.109	5.152	-3.13	0.002	-26.292	-5.925	***
Age-adjustment index	-10.101	1.352	-7.47	0	-12.772	-7.430	***
Early exposure to infections in other countries	16.030	3.218	4.98	0	9.670	22.390	***
Female leadership	-20.178	4.915	-4.11	0	-29.893	-10.463	***
WHOWPR	-10.928	8.599	-1.27	0.206	-27.923	6.068	
Ln average distance to SARS countries	11.928	6.731	1.77	0.078	-1.375	25.230	*
Institutional trust	-41.245	11.026	-3.74	0	-63.037	-19.452	***
Income inequality (Gini index)	0.964	0.255	3.79	0	0.461	1.468	***
Constant	-91.670	59.187	-1.55	0.124	-208.651	25.311	

Mean dependent var	31.979	SD dependent var	38.576
R-squared	0.657	Number of obs	154
F-test	32.39	Prob > F	0.000

**** p<.01, ** p<.05, * p<.1.* Death rate refers to the cumulative number of COVID-19 deaths reported per 100,000 people as of December 31, 2020. One country's early exposure to infections in other countries (on Mar 31, 2020) is the sum of all other countries' cumulative infections on March 31, 2020, weighted by the inverse of the bilateral distance of their capital cities. The bilateral distances are taken from the GeoDist Database provided by CEPII (http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=6). WHOWPR refers to the membership in the WHO Western Pacific Region.

Taken together, the eight variables used in Table 4 explain about two-thirds of the differences in COVID-19 death rates among 154 countries. We have gone partway to understanding what factors have helped or hindered national policy strategies to deal with COVID-19. Ours is not the only analysis to suggest that virus elimination produced better health and economic outcomes.[44] We broaden the range of countries, use a fuller set of well-being criteria, and show the early availability of evidence that we think was sufficient to give a scientific basis for preferring the elimination strategy even before the consequences of the mitigation were starting to unfold.

Conclusions and Qualifications

Given the breadth and consistency of the evidence favouring an elimination strategy, it remains something of a puzzle as to why the elimination strategy was not more widely adopted before the first wave, or even in time to prevent large-scale second and third waves, and the widespread community transmission that has fed the development of more dangerous variants of the virus. One possible reason might be widespread tendency, even for chess masters[45], to stick with established solutions even when the available evidence suggests a fresh and broader look. There was also some evidence of localism at work, with countries comparing their policies and outcomes to those of their nearby neighbours rather than paying more attention to better examples located farther away. Some dismissed the favourable experiences of New Zealand and Iceland to being islands easy to defend from imported infections. Our analysis suggests that it does help to be on an island, but the favourable performance of the Nordic countries (excluding Sweden) within continental Europe shows that high levels of virus suppression and control were feasible even with close proximity to major pools of infection. The Bhutan[46] and Rwandan[47] examples also show that determined policies can deliver near-elimination, while many of the elimination countries have shown the efficacy of using mass testing, tracking, and isolation to stop subsequent imported infections from spreading more widely. Overall, our well-being analysis strongly supports the elimination over the mitigation strategy.

What are the main qualifications to our analysis? First, we limit ourselves to COVID-19 experience in 2020, since it permits ready matching with other data, even if for many countries there were second and third waves in progress that were larger and more damaging than the first. Early evidence from 2021 seems to confirm and even increase the relative advantages of elimination. For example, cumulative death rates to the end of 2020 average 1.5 per 100,000 in the eliminator countries compared to 33.4 in the mitigation countries. By the end of May 2021, the gap had widened further, as by then cumulative COVID-19 deaths were 4.3 per 100,000 in the eliminator countries compared to 69.3 in all other countries.

Second, the survey sample coverage does not include some of the groups likely to have been most harmed by COVID-19, including those living in hospitals, elder care, prisons and other institutional settings, and younger school-age children. If we were able to consider these groups

more explicitly, the well-being preference for the elimination strategy would likely be even larger.

Finally, although we presented evidence that most of the supports for subjective well-being in 2020 were maintained at higher levels in the elimination countries, there is only a modest echo of this in the changes in the life evaluations reported in 2020. The 2021 round of the Gallup World Poll should provide more definitive evidence on this and other elements of the comparison, as more of the delayed consequences for mental health, physical health, social connections and the economy will have become evident.

These qualifications all tend to confirm rather than cast doubt on the conclusions we were able to draw from the evidence currently available. Our basic conclusion is that the absence of significant well-being harms from the COVID-19 elimination strategy, combined with its greater effectiveness at preventing deaths while supporting income and employment, strongly suggests an overall well-being advantage for the elimination strategy. Thus, although there is always more to learn, we believe that our tentative conclusions are likely to continue to hold as history unfolds.

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[1] See World Health Organization (2017).
[2] Recent studies documenting the relative success of the elimination strategy on both economic and direct death grounds include Priesemann et al. (2021) and Oliu-Barton et al. (2021).
[3] See Moghadas et al. (2020), Gandi et al. (2020), Wei et al. (2020), and Savvides & Siegel (2020).
[4] See Emery et al. (2020), Li et al. (2020), Godri Pollitt et al. (2020).
[5] See Asadi et al. (2020), Wang & Du (2020), Yu & Yang (2020), and Sefti et al. (2020).
[6] Despite much evidence of the effectiveness of masks, e.g. Ollila et al. (2020).
[7] See Lewis (2020) on the relative absence of evidence for fomite transmission.
[8] Examples include Arolas et al. (2021), Banerjee et al. (2021), Beaney et al. (2020), Bilinski & Emanuel (2020), Burki (2020), Docherty et al. (2020), Kung et al. (2021), Liu et al. (2021), Locatelli & Rousson (2021), Modig et al. (2021), Rossen et al. (2020), Vieira et al. (2020),
[9] Rossman et al. (2021) find the in-hospital mortality rate for severely ill COVID-19 patients in Israel to be about one-quarter higher during periods of patient overload.
[10] Matthay et al. (2021) estimate roughly 30,000 excess deaths from COVID-related unemployment in the United States from April 2020 to March 2021.

[11] Tanaka et al. (2021) find suicides in Japan significantly down in the early months of the 2020, and then higher in the period July through September, especially among women (Nomura et al. 2020), although still at rates significantly below those of men. More generally, Pirkis et al, (2021) use data from 21 countries to show most countries to have had lower suicide rates during the pandemic, with 12 being significantly lower and none significantly higher.
[12] See Kurita et al. (2021) for such evidence from Japan.
[13] Venter et al. (2021).
[14] See Habib (2020), Ellyat (2020), Baral et al. (2021).
[15] All 20 of the countries in Western Europe have data for both series, while in sub-Saharan Africa excess death data are available for only 1 country of the 49 included in our fuller analysis of COVID-19 death rates.
[16] These are Mongolia, Malaysia, Taiwan, Hong Kong, Thailand, Japan, Singapore, South Korea, and New Zealand.
[17] These are Brazil, Mexico, Costa Rica, Bolivia, Chile, Colombia, Ecuador, Panama, Paraguay, and Peru.
[18] These include Ireland, Taiwan, New Zealand and Luxembourg.
[19] The measure used is 'voice and accountability' or vae for short. Its components include a number of indicators of the quality of government accounts. The data and definitions are available from the World Bank at https://info.worldbank.org/governance/wgi/
[20] The principal change is to Guyana, which was earlier projected to have a 53% growth rate in 2020, a number that has since been adjusted down to 23%. Such extreme changes in growth rates of GDP are not unknown for Guyana, which has a population of less than 1 million, and bauxite production and exports that vary considerably in volume and price. In such cases, GDP is not a suitable measure of either national of especially household income.
[21] See De Neve et al. (2020).
[22] See Longstaff & Yang (2008). For evidence of disasters leading to increases in social trust, see Toya & Skidmore (2014).
[23] See Yamamura et al. (2015).
[24] See Aldrich (2011).
[25] See Lalot et al. (2021).
[26] We do not have data on interpersonal trust and thus are not able to tell if there is a similar impact for it.
[27] See Goff et al. (2018) and chapter 2 of *World Happiness Report Update 2016*.
[28] With sample sizes of 118,000 in 2019 and 105,000 in 2020, these differences are highly significant, as the 95% range for these estimates is of the order of 0.005 on the zero to 1 scale.
[29] Aknin et al. (2021) review a much broader range of evidence on mental health under COVID-19..
[30] See Oliu-Barton et al. (2021).
[31] Australia, although technically a continent rather than an island, is treated as an island for our analysis.
[32] As is shown in the online appendix 2 to chapter 2 of *World Happiness Report 2021*, the equation shown in Table 4 alters very little if median age is used as a simpler alternative to adjustment combining age-specific mortality risks with our combination of age and gender specific mortality estimate rates with each country's actual population profile. If we use the inverse of our age adjustment variable as an alternative, it worsens the overall fit of the equation without materially changing the other coefficients of interest.
[33] The distance data are from Mayer & Zignago (2005, 2011).
[34] See Xia et al. (2004).
[35] See Head & Mayer (2014).
[36] See Poot et al. (2016).
[37] See Sin (2018).
[38] For further analysis of this effect, see Coscieme et al. (2020).
[39] As shown in World Health Organization (2017).
[40] The index for institutional trust is the national average for 2017-2019 of institutional trust (on a scale from 0 to 1) as defined in Table 2.4 of *World Happiness Report 2020* (https://worldhappiness.report/ed/2020/social-environments-for-world-happiness/).
[41] See Wilkinson & Pickett (2014) for a general review of this evidence, and Blundell et al. (2020), Oronce et al. (2020), Demenech et al. (2020), and Elgar et al. (2020) for a COVID-19 focus.
[42] See Rothstein & Uslaner (2005).
[43] See, e.g. Aldrich (2011) for post-tsunami evidence, and Lau (2020) for a COVID-19 application.
[44] Oliu-Barton et al. (2021) compare the elimination and mitigation approaches using two groups of OECD countries. Their elimination group adds Iceland to those OECD countries already in our elimination group (New Zealand, Australia, Japan, South Korea), and also see advantages for elimination over mitigations for both health and economic outcomes. Iceland is part of our group of high-performing Nordic countries.

[45] See Bilalić & McLeod (2014).
[46] See Ongmo & Parikh (2020).
[47] See Cahan (2020).