

COVID-19 Lockdown Policies: An Interdisciplinary Review

Dr Oliver C. Robinson¹

Abstract: Lockdown interventions employed in response to the COVID-19 pandemic have been evaluated via research at biomedical, economic, psychological, and ethical levels of analysis. The aim of this article is to evaluate arguments from these four perspectives simultaneously within an interdisciplinary biopsychosocial review to help inform the political and scientific debate surrounding them. Biomedical evidence from the early months of the pandemic suggests that lockdowns were associated with a reduced viral reproductive rate, but that less restrictive measures also had a similar effect. Lockdowns are associated with reduced COVID-19 mortality in epidemiological modelling studies but not in studies based on empirical data from the COVID-19 pandemic. Psychological research supports the proposition that lockdowns may exacerbate stressors such as social isolation and unemployment that have been shown to be strong predictors of falling ill if exposed to a respiratory virus. Studies at the economic level of analysis points to the possibility that deaths associated with economic harms or underfunding of other health issues may outweigh the deaths that lockdowns save, and that the extremely high financial cost of lockdowns may have negative implications for overall population health in terms of diminished resources for treating other conditions. Research on ethics in relation to lockdowns points to the inevitability of value judgements in balancing different kinds of harms and benefits than lockdowns cause. Suggestions for future research are provided to promote an increasingly fine-grained and nuanced evaluation of these policies.

Keywords: COVID-19, ethics, government interventions, health policy, health psychology, interdisciplinary, lockdown.

Introduction

The COVID-19 pandemic has brought about a dilemma for governments across the world: whether to enforce lockdown interventions to reduce the spread of COVID-19, in the knowledge that such policies contain the potential for harms as well as benefits in managing the pandemic. The academic purpose of this paper is to present a multi-layered interdisciplinary analysis of lockdown measures, via a review of the biomedical, economic, psychological, and ethical arguments for and against them. The practical aim of the review is to act as a resource to help inform future decisions about whether lockdown measures are empirically and ethically justifiable given the complex and varied costs and benefits attached to them.

¹ **Dr Oliver C. Robinson** is Associate Professor of Psychology in the School of Human Sciences at the University of Greenwich, London. He specialises in adult development, qualitative methods and interdisciplinary approaches to topics such as public health policy and the relationship between science, philosophy and spirituality. His personal website is www.oliverrobinson.info
o.c.robinson@gre.ac.uk



Lockdown measures are interventions enacted by governments in response to a pandemic that have all of the following three features (OECD, 2020): (a) A stay-at-home order and/or the requirement to not socialise with other households; (b) the forced temporary closure of businesses, schools and hospitality venues within a region, state or nation; and (c) legal statutes to ensure that violation of these restrictions is a criminal offence punishable by arrest, fine and in some countries such as India, up to two years in prison (Times of India, 2020).

Within these common parameters, lockdown interventions show considerable variety. They vary in duration, relation to the timeframe of a pandemic, severity of measures imposed, and penalties applied for not complying with measures. In terms of the variability in severity of measures, several governments have applied restrictive measures that have been called a lockdown in the media but do not qualify as one by the standard definition presented above. For example, Norway and Finland implemented restrictive measures early in the pandemic such as school closures, limits on the size of gatherings and guidance to work from home, but neither country implemented a stay-at-home order or restrictions on household mixing.

Lockdown measures are a 2020 innovation in pandemic response measures. They have no prior precedent apart from city-wide measures taken in the 1600s to manage plague outbreaks and a lockdown-type intervention involving the complete sealing off of Hoping hospital in Taiwan during the SARS outbreak (Cheung, 2020). The World Health Organisation (WHO) guidelines to handling pandemics published in 2019 does not refer to them. Business and school closures are mentioned in that document as measures of last resort, but there is no mention of stay-at-home orders or restrictions on household-mixing or gatherings (World Health Organisation, 2019). Similarly, lockdown measures are not mentioned in the UK Influenza Pandemic Preparedness Strategy (Department of Health, 2011).

Given the lack of precedent for lockdown policies in pandemic response literature, their mass adoption this year requires explaining. One reason is that China was the first to get the virus and the first to respond with lockdowns and the World Health Organisation then supported their approach, encouraging other countries to follow. China's enforced mass quarantine response was in line with its authoritarian approach to governance (Ma, 2018). China enforced a stay-at-home order in the Wuhan province for two months, with punishments for those who disobeyed. The World Health Organisation then wrote a report in February 2020 in which it appraised these measures in broadly positive terms: "China's uncompromising and rigorous use of non-pharmaceutical measures to contain transmission of the COVID-19 virus in multiple settings provides vital lessons for the global response." (WHO, 2020, p.19)

The next country to experience a major outbreak of COVID-19 was Italy, and the government decided to copy China and implement a stay-at-home lockdown across its northern region. Soon after, Spain and Peru implemented lockdowns, then dozens of other countries followed within a matter of several weeks. Lockdowns had suddenly become the de-facto pandemic response strategy, as countries followed China's lead (Whipple, 2020). Despite previous conclusions in pandemic science that keeping society functioning as normally as possible was the best way of

maintaining population health during a pandemic (Inglesby et al., 2006), the world was launched into a social-political-scientific experiment that continued for the whole of 2020 and into 2021.²

There is an important difference between lockdowns used within countries employing ‘suppression strategies’ and those employing ‘elimination strategies’ in response to COVID-19 (Baker, Wilson & Blakely, 2020). Of the 180+ countries that have reported COVID-19 cases, as of January 2021, four are currently pursuing an elimination strategy. These are China, Taiwan, Australia and New Zealand. In these countries, the aim is to maintain cases of COVID-19 close to zero. The fundamentals of this approach are: (1) complete border closures to foreign nationals until herd immunity is achieved via vaccine, (2) strict quarantine for nationals returning from overseas, (3) highly developed test-and-trace systems, and (4) strict local lockdowns to contain outbreaks. In China, another mechanism at the centre of their elimination approach is mass surveillance via a governmental tracking app (Mozur, Zhong & Krolik, 2020; Zhouziang, 2020). It is expected that the borders of these four countries may remain closed until 2022, with possible exceptions of travel corridors between the countries (Mazzoni, 2020). An elimination strategy requires a number of features: (a) implementation early in the pandemic, (b) a highly developed public health system and IT infrastructure, (c) sufficient affluence to afford the absence of tourist and business travel for up to two years, (d) the capacity to totally close borders. In relation to this last point, three of the four countries are island nations with no land borders, and China, the exception to this, is using military force to maintain fully closed land borders.

The elimination strategy is not available as an option for emerging economies that have neither the infrastructure for such a policy nor the economic resilience to afford a full border closure for up to several years. It is also problematic for many wealthy countries for a variety of reasons. For European Union countries, closing themselves from the rest of the EU for several years is not viable given that the EU is premised on freedom of movement between member states. In the UK, closing the border between Northern Ireland and Ireland for a matter of years is not possible given the Good Friday Agreement. In the USA, states rather than the federal government set COVID-19 policy and there is no way of closing a state off from the rest of the USA. In sum, the elimination strategy remains an option for only a select number of countries.

The potential costs of the elimination approach will be known after the pandemic is over. For example, as of July 2021, much of Australia is currently having to go into another strict lockdown due to rising cases and its adherence to a zero COVID-19 ethos, while much of the rest of the world, including the USA and UK, is opening up. For a comprehensive review of the costs and benefits of it, see Baker, Wilson and Blakely (2020). Crucially, the elimination strategy requires local lockdowns to contain outbreaks. It cannot work without them. Suppression strategies, in which the virus circulates but government measures are taken to manage and slow it, do not inherently require lockdowns. Some countries and states that are employing suppression strategies have implemented lockdowns during the COVID-19 pandemic, but some

²Inglesby et al. (2006, p.373) concluded “An overriding principle. Experience has shown that communities faced with epidemics or other adverse events respond best and with the least anxiety when the normal social functioning of the community is least disrupted. Strong political and public health leadership to provide reassurance and to ensure that needed medical care services are provided are critical elements. If either is seen to be less than optimal, a manageable epidemic could move toward catastrophe.”

have not. The review of the evidence presented below pertains to those countries and states employing suppression strategies.

Moral Reasoning and Complexity in the Context of COVID-19 Lockdowns

A moral dilemma is a decision-making scenario that has a range of possible outcomes that *all* lead to some amount of harm and/or distress. . The issue of lockdown as a pandemic response is an example of a moral dilemma; both enacting and not enacting the intervention leads to negative consequences for some. It is a particularly complex moral dilemma for several reasons. Firstly, the construct of lockdown itself is complex and multifaceted. A lockdown is in fact a composite of various non-pharmaceutical interventions (NPIs), which are combined by governments in different ways. Instead of seeing lockdown as an either-or matter, Altman (2020) argues that they can be conceived in more pluralistic and nuanced way. The range of policies classified together as lockdowns, and the different effects of short-term and long-term ones, means that simply being ‘for’ or ‘against’ will miss a range of intermediary positions. For example, many health professionals in the UK who supported the March-June lockdown did not support lockdown measures applied from September onwards. A good example of this is an open letter from 77 primary care physicians to the British government written in September 2020, which argued that despite their support for the first lockdown, further lockdowns would cause more harm than benefit and so should be avoided (Haynes, 2020).

A popular but artificially simplistic portrayal in the media or in debate is of the lockdown advocate pitted against the lockdown sceptic (e.g. Melnick & Ioannidis, 2020). This is perhaps helpful for debate purposes, but it tends to drive an over-simplistic dualism in media arguments that the only alternative to lockdown measures is letting the virus ‘rip’ through a population uninhibited (Hamzelou, 2020). This is a complete misunderstanding of the range of non-pharmaceutical interventions available during a pandemic, most of which, unlike lockdowns, have a heritage of published research prior to 2020. Haug et al. (2020), whose work is discussed earlier in this article, list dozens of non-pharmaceutical interventions (NPIs) and their relative effectiveness that are not lockdowns, such as border restrictions, banning small gatherings or mass gatherings, quarantining cases, tracking and tracing, public transport restrictions, shielding vulnerable individuals, mask mandates and strategies for communicating information to the public.

A second source of complexity in the lockdown dilemma is the fact that effects of lockdown policies are varied in timing and duration, while spanning biomedical, economic, developmental and psychological outcomes. Altman (2020, p.31) argues that politicians have been focused on COVID-19 statistics to the detriment of considering other effects, due to employing “very narrow and simplistic mental models” and “poor heuristics” to direct policy. Effects of lockdowns include changes to the number of COVID-19 cases, hospitalisations and mortality, but also changing rates of other physical and mental illnesses, plus levels of unemployment, business closures, poverty, and child development. Some of these effects are immediate and short-lived, some are delayed and may last years. Balancing the varied costs of these outcomes requires value judgements, hence a purely objective approach to the dilemma is impossible. For example, what is worse, the death of an 82-year old or a 13-year old who develops a serious

mental health problem that lasts for the rest of his life? The answer to that question is an ethical, not a scientific, matter.

As moral reasoning develops with age and experience, the complexity of moral dilemmas that can be meaningfully engaged with increases. At the heart of moral reasoning theory is how people respond to moral dilemmas (Robinson, 2020). The psychologist Lawrence Kohlberg (1981) theorised that there are predictable, sequential stages of moral reasoning that develop with age, which can be grouped into three main levels; *pre-conventional*, *conventional* and *post-conventional*. *Pre-conventional* moral reasoning (typical of young children) is founded on self-centred concerns about whether or not rewards or punishments will be received for a particular action. Here, the basis for morality is not within the self, but rather is an authority such as parents or teacher. *Conventional* moral reasoning (typical of adolescence onwards) is based on internalising societal conventions of what is right or wrong, and acting morally at this level is seen as integral to citizenship within a society. *Post-conventional* moral reasoning is based on principled reasoning about situations, based on a weighing-up of evidence and risk, while considering ethical principles such as honesty, wellbeing, liberty and justice. This capacity is typically developed in adulthood, but not all individuals reach a post-conventional level (Colby et al., 1983). This stage-based sequence of moral reasoning has been supported in a variety of studies (e.g. Armon & Dawson, 1997).

My aim with the interdisciplinary analysis presented below is to provide a post-conventional consideration of the dilemma of lockdown, which represents the full complexity of the issue, by looking at the problem from biomedical, economic, psychological and ethical levels. All these levels are important in informing a holistic and nuanced conclusion about whether lockdowns are efficacious and ethically acceptable. All these levels of analysis come to bear on a question that is ultimately moral in nature; can the harms caused by lockdown measures be justified by the extent to which they lessen illness and mortality?

The Biomedical Level of Analysis: Effects of Lockdowns on Cases and Mortality

Research on lockdowns at the biomedical level of analysis focuses on the relationship of governmental pandemic interventions to numbers of positive tests, case growth over time, and mortality. The principle argument for enacting lockdowns at this level of analysis is that they temporarily reduced hospital admissions and deaths, via reducing the transmission of viruses between individuals for the period over which the intervention is applied. There is a fast-growing body of evidence that can be used to evaluate whether lockdowns achieve this objective.

Studies that qualified for inclusion in this section on biomedical outcomes were published peer-reviewed articles from March 2020 to January 2021, via the databases MEDLINE and EBSCO Health Sciences database, via one of the following search terms “Government interventions, Distancing interventions, Lockdown” and one of the following search terms: “COVID-19, SARS-CoV-2, coronavirus”. Studies were included that contained empirical data on the association between NPIs and cases or NPIs and mortality, either as part of a natural experiment study or a modelling study.

Research Comparing Countries and States

One of the main methods that has been employed to ascertain if lockdowns are associated with reduced cases and deaths has been the comparison of mortality and cases across countries or states that have applied different levels of governmental response. The following country-comparison studies have studied case numbers in relation to government interventions including lockdowns, and the growing consensus is that lockdowns do reduce the case growth (termed the reproductive number or R), for COVID-19.

Haug et al. (2020) used data on interventions and cases in 226 countries up to 17th August 2020 to run an analysis of the relationship between different government interventions and growth in cases over time. It was found that the most effective method for reducing the rate of growth in cases was small gathering cancellation, followed by school closures and border restrictions. They found that lockdowns do reduce the rate of case growth, but they conclude that “a suitable combination (sequence and time of implementation) of a smaller package of such measures can substitute for a full lockdown in terms of effectiveness, while reducing adverse impacts on society, the economy, the humanitarian response system and the environment.” (Haug et al., 2020, p.1309).

Li et al. (2020) studied data from 131 countries up to June 2020 and found that a decreasing case growth rate over a period of 28 days was associated with school closures, workplace closures, banning public events and a regulation to stay at home where possible. The study also found that while introducing restrictions generally led to a reduction in case growth of 3-24% after 28 days, lifting them led to increases of 11-25%.

Brauner et al. (2020) analysed effects of seven interventions (gatherings limited to 1000 people or less, gatherings limited to 100 people or less, gatherings limited to 10 people or less, some businesses closed, non-essential businesses closed, educational establishments closed, and stay-at-home orders) between 22nd of January and the 30th of May 2020, across 34 European countries and 7 non-European countries. They found that closing educational institutions, limiting gatherings to 10 people or less, and closing face-to-face businesses reduced transmission considerably. However, they found that the benefit of stay-at-home orders, which is the core of a lockdown intervention, was lower in effect than all six other interventions and they describe it as a small effect compared with the large or moderate effects of the other 6 interventions.

Bendavid et al. (2021) studied COVID-19 case growth over time in subnational regions of 10 Northern Hemisphere countries between February and April 2020: England, France, Germany, Iran, Italy, Netherlands, Spain, South Korea, Sweden and the US. They found that implementing non-pharmaceutical interventions was associated with significant reductions in case growth in 9 out of 10 study countries, including South Korea and Sweden (only Spain had a non-significant effect). The study found no benefit of restrictive lockdown interventions compared with the less restrictive interventions applied in Sweden and South Korea. In France, the application of lockdown was associated with higher levels of case growth rates compared with Sweden and South Korea. The study concludes that less restrictive measures generally lead to the same case growth rates as lockdowns.

Islam et al. (2020) looked at government interventions across 149 countries. All the countries in the analysis had implemented at least one physical distancing intervention (closures of schools, workplaces, and public transport, restrictions on mass gatherings and public events, and restrictions on movement (lockdowns)) between 1st January and 30th May 2020. They found that implementing measures without lockdowns led to a greater reduction in cases than those with a lockdown. Overall, they found that the implementation of all these measures reduced the incidence of COVID-19 by a modest 13%. There was a 4% difference in incidence between countries who implemented a lockdown earlier (14% reduction) compared with ones that implemented later (10% reduction).

In summary, the current research suggests that lockdowns do bring down case growth rates but no more so than more moderate and less restrictive interventions. Now I move onto summarising studies on lockdowns and mortality. Firstly, Chaudhry et al. (2020) compared COVID-19 case numbers and mortality data across 50 countries, based on data up to 1st May 2020. They also assessed these countries for the implementation of travel restrictions and containment measures including partial and full lockdown. They found that, in these early months of the pandemic, mortality rates were associated with higher obesity, higher GDP-per-capita, and higher income inequality, but there was no association found between mortality and the use of full lockdown measures.

Secondly, Bjørnskov (2021) investigated the association between severity of lockdown policies in 24 European countries in the first six months of 2020 and excess mortality (all-cause mortality, so not specific to COVID-19). No association between lockdown and mortality was found. Indeed, countries that applied a relatively severe lockdown experienced 372 excess deaths per million, while countries with relatively light restrictions only experienced excess mortality of 123 excess deaths per million.

Thirdly, De Laroche Lambert et al. (2020) in an analysis of 188 countries, using data up to August 31st 2020, found that high COVID-19 mortality was predicted by a country having higher life-expectancy, higher prevalence of chronic diseases such as cancer and heart disease, along with a high level of metabolic risk factors such as an inactive lifestyle and obesity. The stringency of government lockdown response was not associated with mortality.

Fourthly, Meo et al. (2020) compared lockdown measures across 27 randomly selected countries. Prevalence and mortality were measured 15 days before, 15 days during, and 15 days after the lockdown. There was no significant decline found in prevalence or mortality at the 15 day after measurement, when compared with 15 days before or 15 days during the lockdown.

Fifthly, Savaris et al. (2021) conducted an analysis of 87 regions of the world between February and August 2020, focusing on the relationship between deaths and stay-at-home orders. They used a time-series analysis to compare countries that had steady or declining death rates with similar countries where deaths were increasing. Google COVID-19 Community Mobility Reports were used as an indicator of stay-at-home orders. They found “no evidence that the number of deaths/million is reduced by staying at home” (Savaris et al., 2021, p.8).

In contrast, one study by Sornette et al. (2020) that looked at 35 countries (European and North American) found an inverse association between the number of deaths during the 20 days following the date at which cases passed 1 per million within a country and the stringency of government measures 20 days before that date (to allow for the delay between infection and death). Almost all the countries on the intervention census date were still in the first half of March and so had not yet implemented a lockdown. For example, Italy, which had the earliest lockdown on March 9th, but this study looked at their interventions on March 2nd. Thus, this analysis is principally about the effect of interventions enacted *prior* to lockdowns.

The evidence from cross-country and cross-state comparison studies reviewed above is that lockdowns contribute to lowering the reproduction rate of the virus but that some other more moderate policies such as small gathering cancellation may be more effective than blanket lockdowns (Haug et al., 2020). Such evidence is further supported by within-country analyses that have looked at changes following interventions, such as Dehning et al.'s (2020) analysis of German interventions and found that banning small gatherings was particularly effective, and that a combination of interventions in April 2020 helped to reduce the *R* rate. The association between lockdowns and mortality shown by these cross-country and cross-state studies is very limited. The provisional conclusion is that there is no link between lockdown and mortality over the period of the pandemic that has elapsed to the end of 2020.

A caution with all the above research is that the studies are correlational, and there are a range of extraneous variables that can influence how a country or state fares in terms of case and mortality numbers, including population density, ethnic composition, COVID-19 testing capacity/methods, and the way that such data are reported. For example on the latter point, COVID-19 deaths are not defined in the same way across all countries (Sornette et al., 2020). Many of the studies described above do attempt to control for confounding variables, for example obesity and climate, but that does not preclude the possibility of others. Thus, the literature should, despite becoming increasingly consistent and clear, be treated with continued caution.

Computer Modelling Research

A different approach to analysing the effect of government interventions is via computer simulation of the no-intervention scenario. Flaxman et al. (2020) used this approach, looking at deaths attributable to COVID-19 across 11 European countries between February and early May. They modelled the combined effect of social distancing, self-isolation of infected individuals, banning of public events, school closure and stay-at-home orders, and so was not specific to lockdown. The researchers compared the actual mortality in these countries over February-May with a computer simulation of the scenario where no actions had been taken at all. Based on that, the article concluded that the interventions taken by these nations may have reduced COVID-19 deaths by 3 million.

Several commentaries have been critical of Flaxman's study. Soltesz et al. (2020) take issue with Flaxman et al. using their findings to argue that lockdown is effective, as according to the same modelling approach, the public events ban in Sweden was as effective as lockdowns in 10 other countries at driving down infection rates. Kuhbandner and Homburg (2020) in a

commentary on the article presented evidence that the lockdown in the UK (one of the countries in Flaxman et al.'s study) had no effect on deaths at all, given the typical 23-day delay from infection to death. They show that growth was already declining by the time the lockdown would have influenced death rates and there was no shift at all in the downward trajectory of deaths when the lockdown would have potentially come into an effect. Wood (2021) reached the same conclusion in his analysis; infections were in decline before the implementation of lockdowns in the UK.

An epidemiological simulation study by Hsiang et al. (2020) modelled changes in case numbers over time between February and May 2020 across six countries (China, South Korea, Iran, Italy, France and USA) and concluded that, when compared with the computer scenario of no interventions taken, government containment interventions as a whole had reduced the growth rate of infections by a substantial and statistically significant amount. Their conclusion was that these public health policies had slowed the COVID-19 pandemic, and that, up to May, the number of cases and deaths had been reduced.

A limitation of all the aforementioned simulation studies is that they assume a continued exponential rise of virus cases means a doubling every two days in the absence of interventions indefinitely, but research has shown that virus case growth does not continue on a path of exponential growth; infection rates slow and decline of their own accord without any government intervention over a period of approximately 8 weeks (Ben-Israel, 2020). This hypothesis was put to the test when South Dakota had a high surge of COVID-19 infections in October 2020 and subsequently implemented no lockdown or business closures. The surge peaked in mid-October and cases returned close to normal seasonal levels in December, suggesting that 2 months is an appropriate estimate of the timeframe for a virus surge to decline without the use of restrictive interventions. This fact that there is natural remission from exponential growth without intervention means that Hsiang et al. (2020) computer simulations of the no policy scenario were likely overestimations.

In summary, the computer simulation research on combined government interventions has modelled the effect of all public health interventions versus a hypothetical scenario of no interventions taken at all and has concluded that the interventions have been instrumental in slowing the growth of the pandemic over the early months of February to May. What they don't show is the relative merits of lockdowns versus other measures. These models have also been based on parameters about virus growth, population susceptibility and lockdown effectiveness that have been questioned by critics. For example, Chin et al. (2021) describe these models as non-robust and highly sensitive to model specification and parameter selection. The models have also assumed that lowering infection rates also lowers deaths in proportion. However, the cross-country studies suggest that this assumption is unfounded. This may be because the varied collateral damages of lockdowns mean that while case numbers are lowered, susceptibility to serious illness and hence death is increased. I flesh out that claim over the course of the article.

The Biomedical Costs of Lockdown

A limitation with all the research studies discussed above is that they give no or minimal attention to the negative effects of lockdown in their evaluations of whether they work or not

(VanderWeele, 2020). This is equivalent to assessing the efficacy of a drug that has potentially deadly side-effects without any mention of the side-effects.

A key concern about lockdown policies, particularly stay-at-home policies, is that they lead to a decline in uptake of other important health services (Bodilsen et al., 2021). For example, lockdown in the UK led to a 70% decline in cancer referrals (Miles et al, 2020). The drop in cancer diagnosis and treatment has led some cancer specialists to suggest that a cancer pandemic may follow the COVID-19 pandemic (Hanna et al., 2020). An analysis of excess deaths in the UK from delay in cancer treatment during the March-June lockdown suggests that from breast cancer, lung cancer, colorectal cancer, and oesophageal cancer, over a period of 5 years following the pandemic there will be approximately 3300 to 3600 additional deaths. In light of the young age of many of these individuals, the total years lost to life from this cancer surge is calculated at approximately 59,000–63,000 (Maringe et al., 2020).

The challenge with interpreting reduced uptake of other health services during lockdowns is that the extent of such reduction in the event of no lockdown is unclear. People are likely to avoid hospital and medical appointments due to fear of a pandemic virus anyway, irrespective of lockdown injunctions. Future country comparison research on this will help to resolve this question, but until then the matter remains ambiguous.

A final issue in terms of negative effects of extended lockdowns on physical health is the drop in exercise and activity that is evidenced in a proportion of the population (Sport England, 2020). Exercise has been shown to enhance immunity to disease, so when a higher proportion of the population become inactive during lockdown, it is plausible that more individuals will become susceptible to illness when exposed to COVID-19 (Valenzuela et al. 2020).

The Economic Level of Analysis: Cost-benefit Calculations of the Effects of Lockdown

Financial resources for funding medical treatments and interventions are finite. Trade-offs must be made, as money used to fight one disease means funds being unavailable to treat or prevent others (Thomas & Stupples, 2006). A concept that is used by many countries to justify whether a treatment or intervention is worth the cost, in an environment of finite resources, is the “Quality adjusted year of life” or QALY (NICE, 2013; Bertram et al., 2016). One quality-adjusted life year (QALY) is one year of life in good health. Hence, when a young person dies, there is a greater loss of QALYs than when an older person dies. In the UK, the National Institute for Clinical Excellence has a metric to determine whether a treatment is cost-effective and thus should be adopted (i.e. that money is not better spent to save lives and alleviate suffering elsewhere). This metric is £20,000 to £30,000 per QALY saved (NICE, 2013). Other countries set the bar at different levels, but all health services require some kind of quantification in this regard.

Miles et al. (2020) conducted an economic analysis of the costs and benefits of the March-June 2020 lockdown in the UK. They analysed the potential lives saved by the March-June lockdown, on the premise that lockdowns do indeed save lives, then considered the costs of the lockdown in terms of reduced GDP. They found that in all their various calculations, the costs

outweigh the benefits by at least £59 billion (2 million QALYs), and up to £547 billion (approx. 20 million QALYs). The authors concluded, “This suggests that the costs of continuing severe restrictions are so great relative to likely benefits in lives saved that a rapid easing in restrictions is now warranted” (Miles et al., 2020, p. 1).

One other cost-benefit analysis conducted by Israeli researchers found that a lockdown for 200 days would cost \$45,000,000 per saved death, and as such governments should consider this very high economic price when deciding on how long to implement national lockdown interventions, given the inevitable toll on other public services and health services that are affected by reduced funds available (Shlomai et al., 2020).

A multi-faceted analysis of the economic and ethical implications of measures taken by governments conducted by Reddy (2020) expresses concerns that the expenditure and resources invested in lockdowns and other non-pharmaceutical interventions are not proportionate and will, overall, decrease the aggregate population health over time. For example, he makes the point that a 4.9% reduction in world GDP is predicted this year as a result of lockdowns, which is approximately US\$4 trillion. If a world GDP growth of 2% is assumed as the counterfactual for 2020 (lower than recent years), then the cost of non-pharmaceutical interventions taken to combat COVID-19 would exceed US\$5 trillion, which is greater than the total global annual expenditure on all other health issues prior to the crisis.

Reddy (2020) says serious questions must be raised whether lockdowns will, in fact, lower, rather than increase, overall population health over time, due to other health objectives that have lower cost and higher benefit being deprioritised. Consider the following figures as an example: The UK has spent £280 billion on fighting COVID-19, which is considerably higher than the total spending on health and social care in a typical year in the UK, while \$2.6 trillion has been spent in response to COVID-19 in the USA. Meanwhile, the Gates Foundation has estimated that global eradication of malaria by the year 2040 would cost approximately \$120 billion. Such an initiative would potentially save 11 million lives (Savulescu et al., 2020).

A further key issue at the economic level of analysis pertains to the number of individuals being pushed into poverty and/or unemployment during the pandemic. The World Bank has estimated that 150 million people may be pushed into extreme poverty during the pandemic (World Bank, 2020). The Charity UNICEF have explicitly linked this increase in poverty to the negative effects of lockdown policies (UNICEF, 2020), as have other researchers (Broadbent et al., 2020). There is a moderate correlation between GDP-per-capita and life expectancy (0.31 in developed countries, 0.47 in emerging/developing countries), and also between total health expenditure per capita and life expectancy (0.23 in developed countries and 0.51 in developing countries) (Biciunaite, 2014). Thus, we should expect to see a lowering of average life expectancy associated with the declining GDP due to the COVID-19 recessions across the world, and that this will hit emerging economies hardest.

Another form of economic cost-benefit analysis conducted by Thomas (2020a, 2020b and 2020c) has focused on the effect of lockdowns on decreased GDP and hence on mortality. This was established methodology based on a calculation called the J-value, which considers the trade-off between safety-increasing effects and loss of income due to the costs of

implementation. The essence of this approach is to look at the change to *years of life expectancy* (which is very like the QALY concept) that a particular safety intervention brings. In relation to COVID-19 lockdowns, the cost is modelled as the effect on GDP. GDP is a very strong predictor of life expectancy; Thomas' J-value, based on GDP, explains 80 per cent of the variation in life expectancy across 162 nations (Thomas, 2020c). In other words, on average, the wealthier a country is, the longer its people live.

Thomas calculated that a 13% reduction in GDP for the UK was probable, along with an estimate based on previous recessions that the country does not return to pre-pandemic levels until 2022³. The increased impoverishment that this economic shrinkage causes will lead to the loss of 34.9 million years of life expectancy, which is the equivalent loss of 830,000 lives, given the life expectancy of the average UK citizen (Thomas, 2020). Even a scenario in which the pandemic is not controlled by any lockdown, the number of lives lost to the pandemic is a small fraction of the total lost to economic decline and increased poverty. Thomas thus concludes that lockdowns are remedies that may well have costs far worse than the pandemic (Thomas, 2020c).

A potential criticism of this cost-benefit approach is that GDP will be depressed in a pandemic anyway, so it is uncertain how much of GDP reduction is due to the lockdown. Sweden, with no lockdowns implemented, is a useful comparison in this regard; its economy is predicted to shrink by 2.9% during 2020, which is one of the lowest GDP declines in Europe despite mortality rates that are about average across European states (Reuters, 2020). Therefore, we have reasons to believe that lockdowns contribute to the majority of GDP losses.

Closely related to the issue of poverty is the increase in unemployment due to business closures and stay-at-home orders that have been implemented by countries around the world. For example, 400,000 more people in the UK were unemployed in December 2020 than in December 2019 (ONS, 2020). Approximately 5 million more people in the USA were unemployed in November 2020 than in February 2020 (Duffin, 2020), while more than 97,000 businesses had permanently shut across the US during the pandemic up to September 2020 (Sraders & Lambert, 2020). Unemployment is a high-risk factor for mortality. A meta-analysis of the relationship between unemployment and mortality found that the risk of death for unemployed persons was 63% higher than the risk of death for employed persons (Roelfs et al., 2011). While this can be partly explained by chronically ill individuals being more likely to be unemployed, another explanation for this link is that the stress of unemployment has been found to lead to markers of accelerated physical ageing at the genetic level (Ala-Mursala et al., 2013). A further concern is that unemployment rate has a close relationship with suicide rate; Canadian data shows that a 1% increase in unemployment leads to 1% increase in suicide (McIntyre & Lee, 2020), or as much as 2% (Samson & Sherry, 2020). Although suicide numbers overall are small compared with pandemic deaths, they tend to occur in younger adults and so equate to more quality-adjusted years of life (i.e. QALYs) lost.

There is evidence to support the proposition that economic problems driven by lockdowns are associated with mortality during the COVID-19 pandemic. Hasell (2020) has found a strong positive relationship between economic downturns caused by heavy lockdown measures and

³ GDP UK loss from February to October 2020 was 8% according to the Office of National Statistics, thus 13% this is likely to be accurate when the November and January lockdowns are also factored in.

COVID-19 mortality. Peru is a case study in this regard. It implemented one of the toughest and earliest lockdowns in the world (Hannan, 2020). On March 16 2020, when there were only 28 confirmed cases, Peru closed its borders and imposed extreme limitations on freedom of movement. Public transport and cars were banned. Men and women were only allowed to leave their home on alternate days for essential purposes. The restrictions were enforced by the army. This cut down movement and mobility within the country by 89% - more than any other Latin American country (Jaramillo, 2020). Peru has remained in various levels of lockdown for much of the year since then. The effect on the economy of these measures has been stark; the percentage decline in GDP has been the highest of any country in the world, at over 30% (Hasell, 2020). Despite the severe lockdown, as of December 2020 Peru had the fifth worst fatality rate in the world out of 218 countries (Worldometer, 2020). Peru has similar demographics to its neighbours in South America and its health system has similar capacity, so this cannot account for its outlier status in terms of the high numbers of deaths. While there may be an as-yet-unexplained differentiating factor to explain its high mortality rate, one factor that makes Peru unusual relative to neighbouring countries is the extremity and duration of the lockdown measures it employed. Most people in Peru are in the informal economy and work in agriculture, mining and fishing. Most are paid in cash and have little or no savings (ILO, 2018), meaning that Peruvians need money weekly to feed their family. Therefore, for some it may have been a matter of stay in lockdown and starve, or break quarantine to feed your family (Piper, 2020). There is of course also little opportunity for working-from-home compared with developed countries that implemented similar lockdowns and there was no salary furlough scheme as there was in more affluent countries that enacted lockdowns. The sudden poverty, stress and malnutrition that this kind of extreme lockdown drives up in countries like Peru may drive up susceptibility to illness in ways that outweigh the benefits of reduced transmission of the virus. This would at least explain Peru's contradiction between early and extreme lockdown and very high COVID-19 mortality.

One final consideration at the economic level of analysis is whether the approach to the pandemic taken this year is sustainable as an approach to pandemics going forward. If there were another pandemic in 5 years' time, could countries afford to take this same approach again? Many countries will likely still be dealing with the effects of the post-COVID recession, the weight of their increased national debt, and the deleterious effects on social cohesion and mortality that high unemployment brings (World Bank, 2020). It is therefore doubtful that this year's response represents an economically sustainable solution to global pandemics (Farsalinos et al., 2020; Gurdasani et al., 2020).

The Psychological Level of Analysis: The Desire for Paternalism vs Effects of Lockdowns on Loneliness, Anxiety and Behaviour

The psychological level of analysis considers the effects of lockdowns on thinking, emotion and behaviour, along with how these may have impacts on health outcomes. This level of understanding, so often omitted from media coverage, may be key to understanding the reasons why lockdowns do not have notable efficacy over more moderate or voluntary measures.

The first argument in favour of lockdown measures is that it may be what most people want, hence they have a democratic mandate. Polls in the UK showing high support for lockdown

attest to this (Ibbetson, 2020; Smith, 2020). The psychologist Erich Fromm, in his famous book *Escape from Freedom* (1941), theorised that when people perceive an increase in disorder and danger within their community or environment, they feel an existential anxiety that breeds a desire for safety and security via paternalistic and authoritarian forms of governance. An example of this is seen in the actions and rising popularity of Markus Söder, Minister President of the German state of Bavaria. He intentionally implemented more draconian restrictions than other German states, such as a stay-at-home order (only one other state implemented this, while other states did not), and fines of up to €25,000 for non-compliance compared with no fines in some other states (Chae & Park, 2020). Söder was explicit about this approach being paternalistic – he said that "in a crisis, people often want Father to come and sort it out." (Rujevic, 2020). Söder's popularity increased exponentially as a result of his firm approach in the early months of the pandemic (Hockenos, 2020). However, the strict measures applied in Bavaria have not worked. They appear to have been less effective than the more moderate measures taken in other states; Bavaria has had the second highest COVID-19 mortality per capita of 16 German states, as of December 20th 2020. It has over double the mortality rate of seven of these states (Statista.com, 2020).

Another psychological argument presented to support lockdown is that lockdowns reduce the amount of post-traumatic stress disorder associated with bereavement and illness. For example, the UK government has justified its tiered system of mandatory enforcements by arguing that it is likely to lessen the burden from post-traumatic stress disorder, by limiting the number of those infected and who go on to suffer from severe illness (HM Government, 2020). The assumption here is that lockdown measures reduce symptomatic infection more than other non-pharmaceutical measures. The biomedical research reviewed earlier in the article does not provide clear support for this assumption currently.

Contrary to the claims of the UK government that lockdowns reduce anxiety, researchers have found that anxiety and depression both increase with the duration of lockdowns and that lockdowns are a serious threat to mental health (Fiorillo et al., 2020). Research in China also found that anxiety levels in a population go down when lockdowns are eased from 30% to 21% (Lu et al., 2020).

Another study using data from China in February and March found that depression was higher in the lockdown group but fear was not (Gan et al., 2020). In support of this, previous research on the effects of quarantines in prior pandemics suggest that they are related to depression (Brooks et al., 2020).

A recent review study by Cohen (2020) presents the compelling evidence from several decades of studies to show that psychological stress is a robust predictor of whether a person gets ill when exposed to a coronavirus or influenza virus, along with smoking and inadequate Vitamin C intake. The stressful events that were most predictive of coronavirus symptoms were interpersonal stressors and being unemployed. On the other hand, strong predictors of *not* getting ill when exposed to such viruses included social support and physical activity. Cohen concludes that lockdown interventions may *increase* susceptibility to COVID-19 due to their potential for stressors such as unemployment and social isolation, and the closing of environments where individuals retain physical fitness.

Loneliness and Lockdown

The effects of extended lockdown measures in 2020 on loneliness has been researched, and the most recent conclusion is that loneliness may itself be a silent epidemic running alongside the pandemic (Sharpe, 2021). A longitudinal study of 1545 US adults found that from January to April 2020 there was no mean-level increase in loneliness (Luchetti et al., 2020). But as 2020 progressed, the statistics showed growing levels of loneliness. A more recent survey published in December 2020 found that 65% of US adults living under lockdown measures expressed high levels of loneliness, compared with 48% of those living without such restrictions (Killgore et al., 2020). A study from the UK found that loneliness rates in the UK increased from 10% before lockdown to 24% in lockdown (Mental Health Foundation, 2020). As of February 2021, the Office of National Statistics found that levels of loneliness had increased from Spring 2020, up to almost double the national average (Moss & England, 2021).

In the UK, some parts of the country have been under policies that ban almost all social interaction with people outside of one's own household for over four months in total since the start of the pandemic. Correspondingly, a recent report from the Office of National Statistics suggests that loneliness levels in the UK continued to rise all the way from March 2020 to November 2020 (Coughlan, 2020). A study that compared loneliness levels across Denmark, France, the Netherlands and the UK found that the UK's level of loneliness was significantly higher than the other three countries, particularly in individuals with previous chronic illness or mental health problems (Varga et al., 2021).

A major concern with high levels of loneliness during lockdowns is that there is an established body of research showing social isolation to be a very high-risk factor for mortality, comparable to the mortality risk of heavy smoking or obesity (NHS, 2015). A meta-analysis of studies found that social isolation, measured objectively or subjectively, increases the risk of premature death (Holt-Lunstad et al., 2015). After accounting for covariates, the increased risk of death was 26% for reported loneliness, 29% for social isolation, and 32% for living alone. Other studies have found that increasing the amount of social activity experienced by individuals in nursing homes predicts a decrease in mortality (e.g. Hjaltadóttir et al., 2011). One reason that loneliness leads to high mortality is that it brings about an endocrine stress response that impairs immune functioning and thus makes people more susceptible to disease (Cacioppo & Patrick, 2008). For example, one study found that loneliness is associated with poorer antibody responses to the flu virus (Pressman et al., 2005). Another study provided further explanation as to why loneliness affects immune function (Cole et al., 2020). They found that in isolated or lonely participants, leukocytes, white blood cells that are key to the immune system's response to infection, showed an increased expression of genes involved in inflammation and a decreased expression of genes involved in antiviral responses. Further effects of loneliness and social isolation are their impairment of restorative sleep, which leads to greater susceptibility to disease (Hawkey & Cacioppo, 2003). Furthermore, as with unemployment, loneliness brings about a higher risk of suicide, adding to the elevated mortality risk associated with the mass isolation that lockdown policies bring (McClelland et al., 2020).

A marker of those who develop severe symptoms of the COVID-19 disease is impaired immune functioning, specifically interferon deficiency in the blood (Hadjadj, 2020).⁴ Given that loneliness and social isolation are recognised to be as dangerous as smoking when it comes to risk of premature death, extended lockdown policies that prohibit face-to-face social interaction over many months may increase mortality due to immunosuppressive effects, even if they alleviate some mortality via reduced transmission. Thus, what may appear as a COVID-19 death statistic may be partly precipitated by the effects of the social isolation that is inherent in lengthy lockdown interventions, particularly in older adults who are more likely to live alone (VanderWeele, 2020).

As well as impairing immune functioning, the loneliness and social isolation induced by lockdowns may influence behaviour after restrictions are lifted. The argument for this is that human connection is a fundamental need much like thirst or hunger (Cacioppo & Patrick, 2008), that the pent-up need for social contact after a lockdown will mean that many people may compensate for the weeks or months of isolation with a subsequent period of increased social activity (Spector, 2020b). This is what one finds with other unmet needs, for example, if someone is starved of food for days and then allowed to eat, they will gorge themselves as their brain seeks to compensate for the period of lack and scarcity, to bring nutrients back to required levels.

There is some research to suggest that people do indeed respond to the lifting of lockdowns by increasing the amount of social contact to an unusually high level, in ways that not only cancel out the benefits of lockdown but actually make the situation worse than before the lockdown. For example, an analysis of introducing and lifting restrictions across multiple countries found that introducing restrictions led to a reduction in case growth of 3-24% after 28 days, while lifting them led to increases of 11-25% (Li et al. 2020). In other words, after a temporary restriction of social activity is lifted, growth rates tend to increase to a higher level than they were before the lockdown.

More recently, Spector (2020a) has observed this rebound effect in the longitudinal data from the COVID Symptom Study, based on over 4.4 million British participants. He states that there is evidence of a rebound effect after severe short lockdowns, which may cancel out any temporary benefits. More anecdotal evidence from the UK is from media reports of unprecedented crowds in commercial environments directly after the lifting of the recent lockdown on December 2nd. One such report was of ‘mayhem’ as a ‘sea of people’ congregated outside of the Harrods department store on the first weekend after lockdown (Press Association, 2020).

There may be a deeper reason for irresponsible behaviour observed after lockdowns are lifted. Lockdowns work on the basis that a pre-conventional morality, based on the threat of punishment, must be used to enforce correct behaviour during a pandemic. Pre-conventional morality is what one applies to young children; moral guidance is dictated externally by parents, guardians or teachers, and is enforced through rewards and punishments. Young children’s behaviour is managed in this way because they have not developed an internalised ethic of civic responsibility, which is the foundation of conventional morality (Armon & Dawson, 1997). To apply a pre-conventional approach to managing the pandemic therefore means treating adults

⁴ Interferons are signaling proteins released by cells in response to the presence of viruses.

like children. The danger of such an approach is that by engendering a parent-child arrangement of external controls and punishments, lockdowns may actively undermine the tendency of people to behave like adults and to use their own good sense.⁵ This has been discussed in relation to environmental ethical issues; Brisman and South (2015) argue that infantilization leads to irresponsible behaviour in relation to the environment. Evidence also suggests that the imposition of authoritarian policies can quickly reverse a sense of individual responsibility (Douglas Grant, 2019).

A topic that I have not covered systematically within this review is the effect of school closures on children's learning and social development. Many countries and states closed school for months during the COVID-19 pandemic, leading to a range of issues including slowed educational development, stunted social development, and mental health issues in children caused by isolation from their peers (Donnelly, 2021). The omission from this review is because the closure of schools is a pandemic response that may be used as part of a general lockdown or separate from a lockdown, and it has a recognised heritage of use prior to 2020. For a comprehensive review of the harms caused by school closures, the reader is directed to Ballan (2021).

The Ethical Level of Analysis: Evaluating Competing Ethics in Relation to Lockdowns

Scientific and public health advisors help to inform lockdown decision, but the value-neutral data and analyses of science can only be part of the matter when handling a complex moral dilemma such as a lockdown at a governmental level. Politicians must also navigate social, economic, psychological, moral and political trade-offs and competing concerns. Trade-off decisions inherently entail the consideration of values and principles as well as facts (Parry, 2020). Ethics, as the study of such values and principles, must therefore play a part in selecting between competing policy options when considering government interventions for a pandemic (Patton, 2020).

Lockdowns lead to potential harms and benefits to a population, and this is at the crux of the ethical dilemma. The justification of harming some to help others stems from the moral philosophy of utilitarianism. Utilitarian reasoning is based on a consequentialist logic, which justifies an intervention or policy based on whether it leads to more lives saved than lives lost (Reddy, 2020). This is the *saving the greatest number* principle (Otsuka, 2006). Many who warn against lockdowns do so from the same utilitarian ethics, and suggest that lockdowns will likely lead to more death and suffering than they alleviate (Miles et al., 2020; Reddy, 2020).

Consider the following hypothetical scenario: You are a rescuer and there are two boats sinking; one has ten people in it and one has five people in it, but you can only rescue one boat

⁵ A number of legal and political commentators have picked up on this in relation to COVID-19, for example Heffer (2020) wrote: "The Government has infantilized the country by denying people the right to choose what risks to take with their own health; it has taken to itself the duty of personal responsibility, which in a free and properly-run society must reside with the individual." Ridley (2020) has written similarly.

(Bradley, 2009). The utilitarian argument is that one should save the boat with ten people in it. Utilitarianism states that by saving the greater number from death, you will maximize the aggregate sum of welfare (Otsuka, 2006). Enacting a lockdown is a scaled-up version of this kind of dilemma; which proverbial boat – the boat containing people saved by lockdown, or the boat containing people that die as a result of lockdown – has more people in? Resolving this utilitarian puzzle requires very clear evidence on the effects of lockdowns on saving deaths and collateral deaths (Reddy, 2020).

Furthermore, given that those impacted negatively by lockdown, for example via unemployment or mental illness, tend to be younger than those impacted by COVID-19, should that matter? Generally, the utilitarian consensus is that the age of the people on the two sides of the dilemma should matter (Savalescu & Cameron, 2020). The concept of the QALY (quality-adjusted life year) discussed earlier in the article is an example of utilitarian reasoning that takes age into account. More QALYs are saved when the death of a child is avoided than when an elderly adult is saved from death, and that is then factored into the decision to employ a treatment (Reddy, 2020). So, the issue of relative age of those lost to COVID-19 and those who die due to lockdown collateral damage should be considered in the ethical debate.

While some broadly utilitarian cost-benefit analyses have been conducted on mortality caused by COVID-19 versus lockdowns, for example Thomas (2020a), substantive problems remain in using this information to inform political decisions from an ethical perspective, as the more intangible matter of *happiness* is also central to utilitarian moral reasoning. Utilitarian ethics is traditionally about maximising happiness for the greatest number (Stuart Mill, 1879). This of course means saving lives in a pandemic, but is not confined to that. Balancing happiness of the greatest number against saving lives requires subjective judgements of value. For example, the recent decision by many European governments to make social contact with other households at Christmas in 2020 a criminal offence, in order to help keep COVID-19 infection rates down and prevent hospitals from being exceeded in capacity, is an example of balancing happiness against saving lives. The standard ethical judgement for a normal year is that the joys of Christmas outweigh the dangers. Yet, every year across the Northern Hemisphere, hundreds of thousands of elderly adults die from influenza during January and February and hospitals are usually challenged by the numbers who are admitted with infection diseases in those months. Such illnesses will be partly contracted from social gatherings at Christmas. It is therefore likely that hundreds of thousands of lives would be extended if we banned Christmas every year. Critics of consequentialist moral reasoning argue that such deliberations cannot lead to meaningful conclusions (Shermer, 2018). The decision to allow people to gather in groups at Christmas in normal years, such critics say, is more aptly based on *deontological reasoning* about the right way to govern, rather than consequentialist calculations.

Deontological moral reasoning argues that certain kinds of actions are right or wrong no matter what their consequences (Waller, 2005). For example, considering the ethic of consent, consensual sex is right and non-consensual sex is wrong, no matter what the outcome. The philosopher Kant argued that honesty is an ethical principle that should be upheld no matter what the perceived consequences (Shermer, 2018). Critics of lockdown have based their concerns on the fact that lockdowns override the ethical principle of liberty. This ethic is founded on the premise that allowing mentally competent adults the freedom to choose between different

actions, rather than being legally mandated or externally coerced to behave a certain way, supports flourishing societies and human dignity (Tucker, 2020). The principle manifests in a whole range of ways in liberal democracies: freedom of movement, freedom of speech, freedom of assembly, freedom of the press, freedom of religion, freedom of protest, and the freedom to refuse medical treatment (Beauchamp & Childress, 2008; Mandal et al., 2016).

The libertarian ethical argument against lockdowns states that allowing people to take responsibility for their lives and for each other, and so to make their own decisions based on clear information, elicits the best results in the long-term (Sumption, 2020). Most would agree that no-one would accept the kind of authoritarian policies that have been implemented in response to the COVID-19 pandemic on a permanent basis. Why not, *if* they would continue to save lives and drive mortality graphs downwards? Because it is human nature to value liberty and the freedom to live as we wish (Tucker, 2020). Some ethicists who combine libertarian and utilitarian arguments propose that quarantine or lockdown should be applied to the smallest number possible via targeted interventions, for example quarantining the elderly only, given the low risk that COVID-19 means to the under-60s. This is in itself a moral dilemma; I direct the reader to Savulescu & Cameron (2020) for an evaluation of it.

Applying the liberty ethic to public health matters such as lockdowns is based on three arguments that are worth making explicit with examples; (1) belief in the long-term benefits that liberty and autonomy bring despite the short-term risks, (2) the cultivation of trust between government and people and (3) that liberty is a way of ensuring positive community-mindedness. I will briefly review these prior to considering the criticisms of lockdown from a libertarian perspective.

Firstly, the matter of accepting risk. Upholding the political principle of liberty, or the parallel principle of autonomy in medical ethics, means that individuals will take risks and may be harmed or die as a result of them (Beauchamp & Childress, 2008). Despite this, Western medicine and governance are founded on the premise that giving mentally competent adults autonomy in their decisions is worth that risk (O'Neill, 2002; Savulescu, 2017). Take drinking alcohol as an example: It leads to a considerable burden of illness – the World Health Organisation estimates 3 million people die every year around the world as a result of the harmful use of alcohol, which is greater than the COVID-19 death toll for 2020 (WHO, 2018). Despite the clear benefits to public health outcomes of banning alcohol, the decision is left up to the individual.

There is no doubt that legal prohibition of alcohol beverages brings lower numbers of alcohol-related illness, for example in Saudi Arabia where alcohol is banned, alcohol-related deaths are close to zero (World Health Rankings, 2018). And yet democratic societies continue to allow people to have the choice. This is part of a general commitment to the benefits of informed choice. In totalitarian societies, the general population may be safer in some ways, but the requirement to follow strict rules for day-to-day behaviour is known to stifle innovation, happiness and change. It creates stasis and fear while liberal policies allow for flourishing, experimentation and innovation (Kasparov & Halvorssen, 2017).

The second key rationale for the ethic of liberty is that it is central to cultivating *trust* between government and people, or between doctor and patient. When politicians and doctors uphold the right of a citizen to choose their own path, this conveys that they trust those individuals to take their own decisions, and to look after themselves and each other (Warren, 2017). Enforcing compulsory lockdowns via the threat of punishment conveys the message that people can't be trusted to behave well. While there is no doubt that some people would not act in a responsible or trustworthy way during a pandemic, a policy that assumes as much across a whole society is likely to be a self-fulfilling prophecy, for the reasons discussed earlier in the psychological analysis section: If you treat people like children, they will behave like children. Conversely, advisory policies that are based on informed consent, such as those used in Sweden and Japan, assume that people can be trusted. We could hypothesise, based on this, that in countries where authoritarian lockdown measures have been implemented, trust in government will have been eroded during 2020. This has indeed been found in a poll conducted in the UK in October 2020; trust in the British government has dropped to the lowest point in decades (Sugue, 2020). A recent peer-reviewed study has also found a drop in political trust in the UK during the pandemic (Davies et al., 2021). However, it is not clear how much of that is the pandemic response and how much of that is other matters such as Brexit. Future studies comparing trust in government across countries that implemented measures voluntarily or forcibly will be an important area of research in this regard. The potential effects of lockdown on the erosion of societal trust and on a decline in prosocial civic behaviour should not go overlooked.

The third argument for maintain the liberty of citizens in a pandemic is that it has a legacy of promoting positive community-mindedness. Philosophers who have promoted the societal benefits of liberty, such as John Stuart Mill (1860), have emphasised that giving individuals such responsibility and freedom allows for the cultivation of self-control, discipline, restraint, and community-mindedness. These can't be meaningfully cultivated in an environment of coercion and constraint. In support of this assertion that freedom of action actually enhances prosocial behaviour, a recent study found that voluntary social distance measures in the USA were more effective than enforced lockdowns in reducing mortality (Seegert, Yang, Gaulin & Looney, 2020). Another US-based study found that mandatory stay-at-home orders were ineffective because people were modifying their behaviour voluntarily before the mandates were put in place, again supporting the view that prosocial changes are taken volitionally in socially liberal countries (Berry et al., 2021).

Counterarguments to the libertarian critique of lockdowns point out that if a person with a virus is given the autonomy to behave as they want but then does so irresponsibly, they could put other people's lives and health at risk, and that this violates the libertarian ethic of doing what you want as long as it does not harm others (Compton, 2020). However, critics say that risk to others can be managed by more moderate laws and measures that do not require people to stay at home and businesses to close, but instead allow those who choose to congregate in a social environment to do so while mitigating the risk, such as via distancing and masks, much as they do when they drive to work every day or when they drink alcohol.

Another counterargument to the libertarian issue of trust is the argument that if a government failed to control a pandemic, this may lead to a greater loss of trust than that which is compromised by mandatory lockdowns (Spitale, 2020). Given that the current weight of

evidence as it stands suggest that lockdowns do little to control the pandemic in terms of mortality, this counterargument is currently lacking in validity.

In conclusion, a number of ethical principles come to bear on the lockdown dilemma, and some of these are in dialectical tension. All modern liberal democracies combine liberty with some degree of paternalism (Wiley et al., 2013). For example, alcohol and cigarettes are allowed, but most countries ban other drugs. Freedom of speech is allowed, but defamation and slander laws put boundaries around this. Driving cars is allowed despite the high risk of harm, but seatbelts are legally obligated and driving when over the alcohol limit is banned. None of these standard legal restrictions remove civil liberties – they simply put some boundaries on relevant activities. Lockdown interventions, in contrast, temporarily remove some civil liberties completely. The matter of lockdown duration is key. If lockdown is for a short-time frame, for example a month or less, and is implemented at the start of a pandemic only to bide time to understand the disease and develop more targeted measures, this is less ethically problematic than keeping measures in place for many months. If another pandemic arrived soon, and lockdowns were again implemented in extended form, it would arguably start to set a problematic precedent. Ignoring the importance of liberty is, some argue, the slow path towards authoritarian governance (Kasparov & Halvorssen, 2017). Politicians and citizens alike must evaluate how much authoritarianism they consider to be acceptable in the name of saving lives during a pandemic (Wolff, 2020).

As a final point for ethical consideration, given the uncertainty in the current evidence-base for lockdowns, the medical ethic of *non-maleficence* is important to consider. It states that a medical practitioner has a duty to not cause pain or suffering (Beauchamp & Childress, 2008). Thus, in a situation where it is unclear if a new drug will harm more than it helps, the medical establishment would not approve it. If lockdown were therefore a drug, on ethical grounds we would *not* yet prescribe it, irrespective of the cost, until we have clearer information. However, a pandemic undoubtedly brings a range of ethical issues and challenges that are not pertinent to normal treatment approval, so whether or not this ethic is applicable to the lockdown dilemma is one that requires continued consideration.

Conclusions and Future Research Directions

The evidence base about lockdowns is still in a provisional state, as there was no precedent for these interventions prior to 2020. Currently, there is no way of saying with certainty whether lockdown damages will be greater than benefits or vice versa. Overall, the current evidence base leans towards harms outweighing benefits, but this may change if further evidence of a highly significant effect of lockdowns on mortality emerges with a longer timeframe of study across the pandemic that includes the second wave.

Based on the biomedical evidence as it stands at the time of writing, the provisional conclusion is that a combination of moderate measures, such as limiting gatherings to 10 people or less and social distancing, work as effectively as lockdowns to reduce growth in case numbers, without the damages inflicted by the latter. The stay-at-home order appears to be less efficacious than expected. Furthermore, currently, there is little substantive empirical evidence that lockdowns reduce mortality despite lowering case growth rates. This may be due to

immunosuppressant economic and psychological stressors that increase the risk of death in ways that offset the reduced risk of mortality brought by temporarily lower infection rates (Cohen, 2020). This issue should be factored into the continued policy decision-making.

Economic harms of lockdowns have been calculated via modelling the effects of depressed GDP on potential loss of life years, and through calculating the effects on lost resourcing for health more generally. These studies, focused mainly on UK data, have mainly concluded that lockdowns will likely lead to more life lost than life saved.

From an ethical perspective, in addition to the utilitarian ethic of whether lockdowns increase or reduce suffering for the greater number, the matter of liberty must be included in the discussion, just as it has always been part of the discourse on ethics and epidemics (Ries, 2006). In countries that treat people as rational agents, capable of taking care of themselves and others, we know that medicine thrives, the economy thrives, education thrives, the arts thrive and society thrives, when compared with countries that do not allow comparable freedoms (Tucker, 2020). Overriding the liberal ethic of civic responsibility by mandating people to behave in a certain way through threat of punishment may get short-term results, but it may also set a paternalistic precedent of delegating power to authorities and away from the individual. In an international environment where there is already growing authoritarianism (Kasparov & Halvorsen, 2017), that path of social development is unpredictable. Yet there is nothing absolute about liberty; the matter of liberty set against legally mandated constraints is a trade-off balancing act in all areas of governance, and the COVID-19 pandemic is no exception.

All conclusions on lockdowns are provisional given that the literature on lockdown mortality effects will continue to develop across 2021 and there is little published research on the second wave of the virus yet. Furthermore, little is known about the effects of the timing, strictness, and duration of a lockdown. Short lockdowns will have fewer detrimental effects on unemployment and social isolation than longer ones, so the variable of duration must be considered in future studies that have access to data over a longer period of time than currently published studies.

In terms of future research, studies need to investigate how cases and deaths relate to: (a) the timing of the lockdown relative to the course of the pandemic, (b) the duration and severity of the lockdown measures, and (c) whether the lockdown is implemented in an emerging economy with high levels of absolute poverty, or a developed economy where there is a relatively high level of affluence and an employment market based around service and media industries where a large proportion of individuals can work from home. Importantly, the medium-term to long-term effects of lockdown policies must be examined as well as the short-term effects, considering the potential for rebound effects after lockdown, which are likely to be exacerbated by suppressed immunity from lockdown loneliness and inactivity that will likely extend to some degree past the ending of any restrictions.

The collateral damages caused by lockdowns should also be the focus of further study over the coming years. The issues include social isolation, unemployment and depression, poverty and its varied negative effects on health including impaired immune functioning, as well as depleted funds for other forms of healthcare, and issues that relate to communities and families that have been damaged: domestic violence, suicide, crime and more. Future research should aim to

estimate how much more of these problems lockdowns bring compared with more moderate non-lockdown interventions, rather than just compared to a no-intervention scenario, and also how much the potential damage will differentially affect high income countries and middle-to-low income countries.

An evidence-based take on lockdowns is unlikely to reach a categorical conclusion that they do or do not work. A more likely conclusion, given the complexity of the dilemma, is that they may be beneficial at certain points in the pandemic, for example early in the process, but damaging if maintained as a policy over months or years, or that specific interventions within a lockdown may have an acceptable cost-benefit ratio while others do not. The current review has moved the debate forward by being the first to present four levels of analysis – medical, economic, psychological and ethical - that are essential for a full consideration of the pros and cons of lockdowns. The next step is to develop a conceptual integration of these four levels to provide a more unified rubric for political decision-making.

Important Postscript

This manuscript was completed in July 2021. At the time of going to press in December 2021, an up-to-date review of cost-benefit analyses of lockdown measures has just been published that broadly supports the conclusions of this review. It concludes that in all of the 11 cost-benefit analyses published, costs are shown to substantively outweigh benefits (Joffe & Redman, 2021). The authors conclude that lockdowns have “terrible cost-benefit trade-offs” (p.1) and that the continued COVID-19 pandemic response should recognise this and avoid them going forward.

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