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MEDIA RELEASE

AUSTRALIAN COVID-19 RESPONSE INQUIRY APPEARING TO PREPARE FOR A WHITEWASH

APRIL 3, 2024

1. **In September 2023, the Australian Government established an inquiry to assess its responses to the Covid-19 pandemic, so that lessons could be learned in the event another pandemic or crisis developing in the future. The inquiry called for rather limited (3 page) submissions from the public and various organisations so that a body of data, opinions and facts could be fully considered.**
2. **Like many interested and affected organisations, Patrons of Chiropractic Science lodged a submission, which was accompanied by peer reviewed, published studies supporting each of its statements. Last week, the inquiry published these submissions on its website: https://www.pmc.gov.au/covid-19-response-inquiry. The PCS submission is listed as No: 0623. However, unusually, many factual sections of the PCS submission were redacted from public view and the attached studies were removed, as were critical sections of many other submissions. One might argue that the inquiry panel did not wish to fully present to the Australian public such views or include them in its considerations.**
3. **PCS has therefore released its submission in full via this media release, and the media and public can then access the accuracy of the PCS statements and consider the value of such a heavily censored inquiry.**
4. **Whitewash: to exonerate by means of a perfunctory investigation or through biased presentation of data.**

When the Australian government called for public submissions, such submissions that have been approved for publication by their authors should be presented in full, as heavily redacted sections of factual statements (that do not contain bad or insulting language), only leads the public to a lose trust in the veracity of the inquiry conclusions and recommendations. It also suggests the inquiry is unlikely to find fault with certain decisions that may have actually been flawed, such as the persistent support of certain Covid-19 vaccines, that now appear to be causing considerable harm and adverse reactions.

Accordingly, PCS calls on the Australian Government to direct the inquiry panel to carefully consider each submission and publish submissions in full, where the authors have provided their approval, and to only redact offensive language.

PCS later offered to the Inquiry to facilitate a meeting with a leading international virologist to explain why the original Covid-19 virus so quickly mutated and discuss the efficacy of the vaccines. To date, the Inquiry has refused to participate in such an informative discussion.

The Australian Federal Government managed and coordinated the Covid-19 vaccine program and its agencies approved these vaccines, so this aspect must be included in the Covid-19 Response Inquiry terms of reference. Given the mounting evidence of serious adverse reactions associated with these vaccines and the unexplained excess global mortality that coincided with the vaccine mandates, PCS calls for the suspension of the Covid-19 vaccination programs, and recommends that the government launches and fully funds, an independent investigation, conducted by reputable, independent and qualified scientists that have no ties or allegiances to any pharmaceutical companies or the health departments that so willingly approved these vaccines, to critically assess the safety and efficacy of the Covid-19 vaccines. Such research must also include a critical comparison assessment of excess mortality between the Covid-19 vaccinated and unvaccinated.

Christopher Hart
PCS President

Jackie Malady
PCS Secretary

Attachments:
PCS submission to the Covid-19 Response Inquiry in full – Dec 2023
Turni et al, Covid-19 Vaccines – An Australian Review – Sept 2022
Letizia et al, SARS-CoV-2 Transmission amoung Marine Recruits during Quarantine – Nov 2020
Bjorkmmanm et al, The Swedish Covid-19 approach: a scientific dialogue on mitigation policies – July 2023
Bardosh et al, How did the Covid pandemic response harm society? A global evaluation and state of knowledge review (2020 – 2021) – May 2023
Rancourt et al, Probable casual association between Australia's new regime of high all-cause mortality and its Covid-19 vaccine rollout – Dec 2022

Patrons of Chiropractic Science is a research organisation and registered Australian charity that focuses on Chiropractic clinical research, publication and review of peer reviewed studies and general public health matters.

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SUBMISSION TO THE COVID RESPONSE ENQUIRY

DECEMBER 2023

This extremely limited three page submission is made by the Patrons of Chiropractic Science ("PCS"), a charitable research organisation with 130 members (and broader reach to the 6176 registered Australian chiropractors), dedicated to the advancement and development of appropriate and relevant chiropractic research to demonstrate and explain the mechanisms that underlie the effectiveness of chiropractic care and its positive health impact across all age groups. As PCS represents practising primary contact practitioners, who then offer health advice to thousands of patients, its objectives extend to more general health matters that may be influenced by policies, directions and mandates that are established and articulated by governments and their health advisors.

Introduction:

In February 2020, PCS, like many health related organisations, began to focus of the developing SARS-CoV-2 epidemic, named Covid-19 disease. PCS's approach was to develop general health advice for wider publication to assist in the prevention and mitigation of a Covid-19 infection. This interest became personal to its board members, as one of the PCS founders and his wife (both in their late 60's) contracted Covid-19 on March 12, 2020 from a visiting friend who was teaching in South Korea. While suffering flu like symptoms for 3-4 days, including loss of taste and production of copious amounts of respiratory tract phlegm, natural common sense approaches were immediately implemented. PCR testing was limited at that time, but subsequent tests a couple of weeks later possibly confirmed Covid-19 infection. The infection treatment responses included; bed rest, high does of vitamin C, A, D (if direct sunshine was not available), selenium and zinc. Sensible diet included absence of processed foods and focus on whole natural foods and pure water. Natural recovery took approximately 2 weeks.

PCS then embarked on a Covid-19 data review and public health information program, commencing on April 20, 2020 with a series of press releases and letters to nearly every media outlet and most Health Ministers and their senior advisors (approximately 1600 recipients each release). What was apparent from Federal and State government responses was a complete lack of positive, general health advice and many unsubstantiated statements from Premiers and Chief Health Officers that were described as being based on "science" and "evidence", when clearly the science and evidence was either missing, dubious, anecdotal or contested. Statements were all doom and gloom! Alarmingly, any individual or organisation questioning such statements and directives, some by extremely eminent and respected experts in the fields of epidemiology and virology, were attacked, insulted, vilified and in some cases threatened with deregistration or loss of tenure. **This is not how the scientific process is conducted.**

PCS's letters and releases for the next five months questioned the lack of positive health advice, the effectiveness and dangers of extended harsh lockdowns, effectiveness of the facemask mandates, the similarity in mortality of Covid-19 to seasonal influenza (which in 2017 resulted in 1200 deaths yet apparently did not concern the health authorities enough to introduce similar harsh mandates), the validity of PCR testing and evidence that the "positive" PCR test result numbers (possibly over-inflated many times) were actually the basis of the claimed pandemic, not actual Covid-19 case numbers.

However, the most significant concern PCS had was the concept of a rushed, poorly tested, new experimental mRNA vaccine for a SARS type virus, when all previous attempts to manufacture a vaccine (SARS-CoV-1 & MERS), had failed to produce a safe or effective product and in testing had triggered some extremely negative serious adverse reactions and even death of test subjects.

PCS is not opposed to the use of vaccinations as a method to improve public health and some levels of immunity, but it is highly concerned when a new vaccine is considered safe and effective after a few months of internal testing by self-interested manufacturers, and particularly when such manufacturers refuse to release the full randomised control trial (RCT) data of serious adverse events, or used screening

techniques that excluded those test subjects experiencing serious reactions after the first vaccine shot from the published data. Given these concerns, in September 2020, PCS wrote directly to the Federal Health Minister, the Prime Minister and each State Health Minister to warn that all vaccines must be carefully and independently tested, trialled and verified over a protracted period. Copies of these letters can be provided, but not when a submission can only be 3 pages long and include 4 attachments. All previous vaccines have required 5 to 10 years to achieve the correct safety and efficacy standards.

The myopic focus on a saviour of such experimental vaccines only occurred because of the fear and panic the so called experts generated, both within government and amongst the public, even in the face of mounting evidence that Covid-19 illness and mortality was similar to a bad seasonal influenza. Their actions were further compounded by a dependence on this panacea. **This is a primary lesson to learn.** We now have a situation where it is entirely possible that the mortality arising directly from the serious adverse reactions of the Covid vaccines will be far worse and long reaching than the actual disease it was supposed to prevent. Further, the behaviour of most senior health officials to continue to deny this vaccine harm, and even worse, to continue to recommend vaccine boosters is a national disgrace, and is only brought about from fear of litigation, ballot box reprisals or plain stubborn ignorance.

Major points and references:

1. **Lockdowns:** there are many conflicting studies that make it impossible to directly assess the effectiveness of this approach, particularly when this strategy is used by an over zealous Premiers, rather than application of limited, sensible, considered restrictions, combined with effective protection of the most vulnerable (over 75 years of age). Victoria is a perfect case, where its lockdowns were the longest and most severe in the western world, and yet resulted in the highest direct Covid deaths in 2020 (ABS): Victoria 805, Australia total 906, and directly caused the greatest economic harm, mental illness issues and many unrelated health issue exacerbations due to lack of access to treatment. In particular, this highlighted what happens when health decisions do not correctly target the most vulnerable (retirement homes) and selection of a dubious company for hotel quarantine security that had no experience but was owned by a Union mate. While there will be many views, perhaps a good example of a country that minimised lockdown and mask mandates was Sweden. We encourage you to carefully study the data, which confirms they did not experience greater mortality and yet saved their economy and public mental health. PCS offers an excellent summary of lockdown effectiveness, viewed on this video clip, where Prof Stefan Homburg recently gave a speech at the German Parliament Corona Symposium in the issue: https://www.youtube.com/watch?v=UB8DHr-ofFc
2. **Facemasks:** In the very early stages of the epidemic (May 2020), the USA Centre for Disease Control (CDC) announced a review of around 40 studies on the effectiveness of masks in protection from influenza transmission, selected 14 RCTs were viewed as the most robust studies, and concluded there was no statistical benefit in using a mask. This is supported by other peer-reviewed studies that have failed to confirm a statistical reduction in the spread of viral infection when using a facemask in any setting (Balazy et al, Jacobs et al, Milton et al, Cowling et al, bin-Reza et al, Smith et al, Offeddu et al). SARS-CoV-2 is about the same size as the influenza virus (0.12 micron). Masks are believed to be effective to 0.3 micron. Ordinary cloth masks (promoted by government as a "good" alternative, have pore sizes between 80 to 500 microns). However, these studies dealt with influenza, but there were two specific studies at the time directly related to Covid-19 transmission, that seemed to suggest SARS transmission may actually increase with the use of masks: the Danish 2020 Bundgaard RCT, and the 2020 NEJM Letizia et al marine recruit study. It is the view of PCS that the apparent increase in transmission did not relate to the effectiveness of masks, but rather contamination from the poor practice of constantly adjusting the mask position with fingers at the moist point of high viral loading over the mouth area. Again, in Victoria, the mandate for masks was a "Captains call" as no evidence could be established to support implementation, other than anecdotal charts of a couple of countries showing a continued downward infection rate trend line with the mask mandate date inserted. Even the manufacturers of N95 and ear loop face-masks (much better quality than approved cloth masks) state "WARNING: this product is not a respirator and will not provide any protection against Covid-19 (Coronavirus) or other viruses or contaminants. Wearing an ear loop mask **does not reduce the risk** of contracting any disease or infection". **Governments should take notice**.

3. **RT-PCR Tests:** PCR tests are inherently inaccurate. The Nobel prize winning inventor of the PCR test, Kary Mullis, stated the test should not be used to diagnose a disease. Viral RNA particles captured by a PCR swab must be amplified. Science confirms any amplification over 35 times renders a PCR test clinically unreliable. Current PCR tests for Covid-19 are amplified 45 times or more, which leads to many false positive test results. Most virologists estimate that with large numbers of the population being tested, the likelihood of a positive PCR test actually being a false positive is between 89% to 94%. Yet most government actions, fear mongering and mandates were driven by daily PCR test result values. **Do not use PCR testing to assign a value of infections, particularly where the amplification multiplier is greater than 25.**
4. **Covid-19 Vaccines:** There are two critical measures: safety and efficacy. **All Covid-19 vaccines fail in both measures.** Where can any organisation start with this subject, as it is impossible to adequately deal with this matter in the remaining half page. As stated above, vaccine development has for the past 70 years required extensive and careful development, over a protracted period of years, and this is for well proven vaccine models, not an entirely, untested, experimental mRNA product. While PCS accepts all governments panicked and blindly entrusted total faith in the likes of Pfizer (the most heavily fined and penalised pharmaceutical company for serious breaches and dishonesty of all kinds), and a tin-pot inventing company, Moderna (which had never produced an approved product of any kind), to save the day, their primary duty was to the public and its safety. All governments, and worse, their "experts", blindly accepted that these rushed vaccines would both protect and limit transmission. Pfizer and Moderna claimed a 95% risk reduction in infection, which governments accepted and widely promoted, yet the correct measure to use was the Absolute Risk Reduction: 0.89%. (i.e. for every 119 individuals vaccinated, only one would be protected from Covid infection; source The Lancet 2021). **They all lied to Australians**.
   On October 25, 2022, PCS issued a media release stating recent papers present mounting evidence of unacceptable risks of the mRNA Covid vaccines. These peer reviewed and published studies and articles were attached to the release. Another peer reviewed study published in the Journal of Clinical & Experimental Immunology (Covid-19 Vaccines – An Australian Review; Vol 7 Issue 3: September 2022, Turni et al) again indicated that mRNA Covid-19 vaccines have a greater risk of causing a serious adverse reaction, resulting in hospitalisation and/or disability, than being hospitalised from Covid infection. Turni raised valid concerns about efficacy and safety, and listed many unaccounted serious adverse events, including myocarditis and pericarditis. In conclusion, Turni notes that never in vaccine history have 57 leading scientists and policy experts released a report questioning the safety and efficacy of a vaccine (Bruno, R., Mccullough, P.A., Forcades, I., Vila, T. et al. 2021, SARS-CoV-2 mass vaccination: Urgent questions on vaccine safety that demand answers from international health agencies, regulatory authorities, governments and vaccine developers, May 24, 2021). They not only questioned the safety of the current Covid-19 injections, but were calling for an immediate end to all such vaccination. Many doctors and scientists around the world have voiced similar misgivings and warned of consequences due to long-term side effects. Yet there is no discussion or even mention of studies that do not follow the narrative on safety and efficacy of Covid-19 vaccination. Now every country around the world, but particularly those that forced Covid vaccines on their constituents, are now facing the impact of the significant rise in unexplained excess mortality. The reason is clear, and eventually will be proven to be the rushed, experimental Covid-19 vaccines. Further, a number of leading virologists insist that a vaccination program should never be implemented during a pandemic, as it will generate many variants, often more dangerous that the original strain. Guess what has occurred?
5. **In Summary:**
   a. **Do not accept any advice or evidence from parties that are conflicted or have vested interests in a product or vaccine. This includes those who staked reputations on a particular view or advice and now resist any admission that they may be wrong.**
   b. **Australia must commit to its own independent testing and approval of new vaccines, but particularly a novel, experimental, unproven product. Its authorities must be extremely sceptical of any pharmaceutical company refusing to release all RCT data.**
   c. **Health is a personal choice, so to mandate any intervention is unethical and possibly illegal. Any such intervention can only be offered under the accepted standards of informed patient choice, so to mandate enforcement of an experimental vaccine/medication or lose ones job is a National disgrace.**

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Review Article

Journal of Clinical & Experimental Immunology

COVID-19 vaccines – An Australian Review

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Abstract

After millions of people have been vaccinated as often as four times within a year, the effects of these vaccinations are slowly becoming apparent. This review has been written from an Australian perspective with the main focus on the COVID-19 mRNA vaccines. We will look at the promises/predictions originally made and the actual facts. We will evaluate the safety and efficacy by looking at the literature and the data from government agencies. The literature review will be summed up in a table listing the so far reported side effects of which many are very serious including death, with this data coming from 1011 case reports. Long term side effects will also be covered and the risk benefit ratio will be explored. The review is ending with some very critical question that need further discussion.

Introduction

This review is written from an Australian perspective and will concentrate on the COVID-19 mRNA vaccines. In Australia the COVID vaccination is still heavily promoted. Until April 2022 only the mRNA vaccines Comirnaty (Pfizer) and Spikevax (Moderna), as well as the vector vaccines Vaxzevria (AstraZeneca) and COVID-19 Vaccine Janssen (Janssen) were preliminarily registered for use. Every one of these vaccines forces the vaccinees body to produce the spike protein for which the genetic code is delivered into the cells as mRNA via a nanoparticle or as double stranded DNA via a viral vector. (https://www.tga.gov.au/international-covid-19-vaccines-recognised-australia).

In April 2022 yet another vaccine, Nuvaxovid (Biocelect on behalf of Novavax, based on a new concept) received preliminary approval in Australian. Nuvaxoid contains a modified spike derived from moth cells cultured after transfection using Baculovirus, which express the spike protein on their cell membrane. This spike protein is harvested and assembled onto a synthetic lipid nanoparticle, which displays 14 spike proteins each. (https://www.precisionvaccinations.com/vaccines/novavax-covid-19-vaccine). The vaccine is registered for 18 years of age and older.

The government continues to push particularly the mRNA vaccinations by encouraging a fourth vaccination and recommending the vaccine for pregnant women as well as children 5 to 11 years old. The official public message is that the mRNA vaccines are safe. However, the Therapeutic Goods Administration (TGA), the medicine and therapeutic regulatory agency of the Australian Government, states quite clearly on their website that the large-scale trials are still progressing and no full data package has been received from any company. The TGA is currently getting rolling data and safety and effectiveness are still being assessed (https://www.tga.gov.au/covid-19-vaccines-undergoing-evaluation).

Initial information

The mRNA vaccines were supposed to remain at the injection site and be taken up by the lymphatic system. This assumption proved to be wrong. During an autopsy of a vaccinated person that had died after mRNA vaccination it was found that the vaccine disperses rapidly from the injection site and can be found in nearly all parts of the body [1]. The mRNA is enveloped in liquid nano particles (LNP) containing a mixture of phospholipids, cholesterol, PEGylated lipids and cationic or ionizable lipids [2]. Research has shown that such nanoparticles can cross the blood-brain barrier [3] and the blood-placenta barrier [4], so it came as no surprise that the European Medicines Agency assessment report for the Moderna vaccine on page 47 (https://www.ema.europa.eu/en/documents/assessment-report/spikevax-previously-covid-19-vaccine-moderna-epar-public-assessment-report_en.pdf) also noted that mRNA could be detected in the brain following intramuscular administration at about 2% of the level found in plasma. In 2021 researchers from Japan reported a disproportionately high mortality due to cerebral venous sinus thrombosis and intracranial haemorrhage. Despite not being able to prove a causal link with vaccines, as no autopsies were performed, they still believed that a link with vaccination is possible and further analysis is warranted [5].

It was furthermore stated that the mRNA will degrade quickly. Normally, mRNA breaks down within a few minutes to hours, however, the mRNA in these vaccines is nucleoside-modified to reduce potential innate immune recognition [6, 7] and it has been shown that production of the spike protein in some vaccines is kept up for an extraordinarily long time. A study by Röltgen et al. [8] found that the vaccine mRNA persists in the body up to 60 days, with 60 days being the end point of their study. It is thus unknown and impossible to define how much of the spike protein is actually produced in the vaccinated. It is a standard requirement for vaccine producers to define the amount of antigen in each injection. For a "so called "vaccine that is using the human body as the production facility there is no possible quantification of antigen. This is highly variable and dependant on the amount and stability of nanoparticles in the injection, age and fitness of the vaccinee, their immune status and the injection technique – if a blood vessel is directly injected, the nanoparticles will travel in minutes to all major organs including the brain. It is therefore impossible to assess how much spike protein any individual vaccinee produces following an inoculation. In summary, it is unknown where exactly the vaccine travels once it is injected, and how much spike protein is produced in which (and how many) cells.

Prominent cardiologist Dr Peter McCullough stated that the spike protein - a cytotoxin solely responsible for the severity of the respiratory infection - makes the use of it as immunizing agent dangerous. The spike protein in itself can produce COVID- 19 symptoms as shown in animal experiments. The S1 subunit of the SARS-CoV-2 spike protein when injected into transgenic mice overexpressing human ACE-2 caused a COVID-19 like response (a decline in body weight, dramatically increased white blood cells and protein concentrations in bronchoalveolar lavage fluid (BALF), upregulation of multiple inflammatory cytokines in BALF and serum, histological evidence of lung injury, and activation of signal transducer and activator of transcription 3 (STAT3) and nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB) pathways in the lung [9].

It was further shown that the spike protein S1 subunit, when added to red blood cells in vitro, could induce clotting by binding fibrinogen and ACE2 on platelets, thus triggering their aggregation [10]. The S protein also increases human cell syncytium formation, removes lipids from model membranes and interferes with the capacity of high-density lipoprotein to exchange lipids [11, 12]. Another in silico study showed that the spike protein S2 subunit specifically interacts with BRCA-1/2 and 53BP1 [13]. BRCA-1 is frequently mutated in breast cancer in women and prostate cancer in men, while 53BP1 is a well-established tumor suppressor protein.

A paper published by Liu et al. conducted single-cell mRNA sequencing of peripheral blood mononuclear cells (PBMCs) harvested from patients before and 28 days after the first injection of a COVID-19 vaccine [14]. While this vaccine was based on an attenuated virus and not a mRNA vaccine, it also is injected directly into the deltoid muscle, bypassing the mucosal and vascular barriers.

The authors found consistent alteration of gene expression following vaccination in many different immune cell types. One housekeeping gene of high importance is RNA polymerase I (POL I) which transcribes ribosomal DNA into RNA and monitors rDNA integrity in the process. Many of the downregulated genes identified by Liu et al. (2021) were linked to the cell cycle, telomere maintenance, and both promoter opening and transcription of POL I, indicative of impaired DNA repair processes [14].

Seneff et al (2022) describe another mechanism by which the mRNA vaccines could interfere with DNA repair [15]. The microRNA miR-148 has been shown to downregulate homologous recombination in the G1 phase of the cell cycle. MiR-148 is one of two microRNAs found in exosomes released by human cells following SARS-CoV-2 spike protein synthesis in the experiments by Mishra and Banerjea [16].

Natural immunity ignored

It is an amazing fact that natural immunity is completely disregarded by health authorities around the world. We know from SARS-CoV-1 that natural immunity is durable and persists for at least 12-17 years [17]. Immunologists have suggested that immunity to SARS-Cov-2 is no different. The human population has encountered and co-existed with a great number of coronaviruses throughout evolution. Most of us have cross-reacting T-cells, B cells and antibodies derived from encounters with common cold coronaviruses that can recognise SARS-CoV-2 [18-20]. A survey of more than 100 immunologists, infectious-disease researchers and virologists working on the coronavirus, who were asked whether the virus could be eradicated, showed that almost 90% of respondents believe that the coronavirus will become endemic [21]. The four human coronaviruses that cause common colds are also endemic, without there ever having been a vaccine for any of them. The existence of related viruses might explain that approximately 40% to 45% of COVID infected people are asymptomatic and about 80% of COVID cases are mild infections. In some cohorts, the asymptomatic infection figure jumps as high as 96% depending on the age and cross-immunity imparted by other viruses such as beta coronaviruses HCoV-OC43 and HCoV-HKU1, which have been proposed as a mitigating factor in the spread of SARS-CoV-2 [22-23].

The Brownstone institute has established the most updated and comprehensive library list of 150 of the highest-quality, complete, and robust scientific studies and evidence reports/position statements on natural immunity as compared to the COVID-19 vaccine-induced immunity. The consensus of these studies is that immunity induced by COVID infection is robust and long lasting (https://brownstone.org/articles/79-research-studies-affirm-naturally-acquired-immunity-to-covid-19-documented-linked-and-quoted/).

When comparing the immune response to vaccination and natural infection, differences in the responses were detected. For example, a strong upregulation of genes associated with type I interferon production, cytotoxicity and an increase in circulating plasmablasts were only observed after natural infections [24]. In contrast, mRNA vaccines seem to suppress interferon responses [25]. A literature review by Cardozo and Veazev [26] concluded that COVID-19 vaccines could potentially worsen COVID-19 disease through antibody-dependent enhancement when natural infection occurs after vaccination, regardless of the delivery mechanism - vector or LNP containing RNA – of the nucleic acid coding for the spike protein.

A retrospective cohort study from Sweden revealed that individuals who survived and recovered from a previous infection had a lower risk of COVID-19 re-infection and hospitalisation for up to 20 months. The authors concluded that both previous infection and vaccination should be sufficient proof of immunity to COVID-19 [27, 28].

When comparing 2,653 fully vaccinated individuals with 4,361 individuals recovered from COVID-19, initial levels of antibodies were higher in the vaccinated but decreased exponentially and much faster than in individuals recovered from COVID-19 [29].

There have been discussions about risk and value of vaccination in the previously infected part of the population. Study results have shown that the second dose in people already exposed to the virus leads to a reduction of cellular immunity, inferring those individuals previously infected with COVID-19 should not get a second injection [30].

All of these facts should have led to the standard operating procedure of establishing antibody titres in patients before vaccination for SARS CoV-2, similar to other vaccinations. However, this did not happen and natural immunity is still not accepted as proof of immunity in Australia.

Protection

The vaccine was never meant to prevent the spread of the virus, but to decrease disease severity. A study at the University of California followed up on infections in the workforce after 76% had been fully vaccinated with mRNA vaccines by March 2021 and 86.7% by July 2021. In July 2021 75.2% of the fully vaccinated workforce had symptomatic COVID [31].

Paul Elias Alexander pointed out this troubling situation in an article published by the Brownstone Organisation by citing three studies where we see this emerging situation of the vaccinated increasingly being infected and transmitting the virus. The study by Chau et al. reported a seminal nosocomial outbreak occurring in fully vaccinated Hospital Care workers (HCW) in Vietnam in 2021 [32]. The second study described an outbreak in a Finnish hospital where the virus spread among HCWs and patients [33]. In this study the Delta variant of the virus was introduced by an inpatient. Both symptomatic and asymptomatic infections occurred among vaccinated HCWs. Secondary transmissions were observed from those with symptomatic infections despite the use of personal protective equipment. The third publication detailed an outbreak in an Israeli hospital, where the virus spread among vaccinated HCWs and vaccinated patients [34]. (https://brownstone.org/articles/79-research-studies-affirm-naturally-acquired-immunity-to-covid-19-documented-linked-and-quoted/).

Acharya et al. (2021) and Riemersma et al. (2021) both showed that the vaccinated have very high viral loads similar to the unvaccinated and are therefore as infectious [35, 36]. Brown et al. (2021) and Servelitta et al (2021) suggested that vaccinated people with symptomatic infection by variants, such as Delta, are as infectious as symptomatic unvaccinated cases and will contribute to the spread of COVID even in highly vaccinated communities [37-38].

A study from the US found that increases in COVID 19 cases are unrelated to levels of COVID-19 vaccination across 68 countries and 2,947 counties in the United States. On the contrary, it seems that countries with higher vaccination rates have also higher caseloads. It was shown that the median of new COVID-19 cases per 100,000 people was largely similar to the percent of the fully vaccinated population [39].

Multiple recent studies have indicated that the vaccinated are more likely to be infected with Omicron than the unvaccinated. A study by Kirsch (2021) from Denmark suggests that people who received the mRNA vaccines are up to eight times more likely to develop Omicron than those who did not [40]. This and a later study by Kirsch (2022a) conclude that the more one vaccinates, the more one becomes susceptible to COVID-19 infection [41].

This has to be seen in context with the small risk of dying from COVID-19. A recent peer-reviewed review paper by one of the world's most cited and respected scientist, Professor John Ioannidis of Stanford University notes an infection fatality rate (IFR) for Covid of 0.00-0.57% (0.05% for under 70s), far lower than originally feared and no different to severe influenza [42]. The chances of someone under 50 years old with symptoms dying from COVID-19 is 0.05%. The chances of someone under 18 years old dying from COVID is near 0%. Those that die usually have severe underlying medical conditions. It is estimated that children are seven times more at risk to die from influenza than from COVID-19.

A worldwide Bayesian causal Impact analysis suggests that COVID-19 gene therapy (mRNA vaccine) causes more COVID-19 cases per million and more non-Covid deaths per million than are associated with COVID-19 [43]. An abundance of studies has shown that the mRNA vaccines are neither safe nor effective, but outright dangerous. Never in vaccine history have we seen 1011 case studies showing side effects of a vaccine (https://www.saveusnow.org.uk/covid-vaccine-scientific-proof-lethal).The

Covid-19 Vaccine Monitor, an interim study report for cohort event monitoring of vaccinated persons in the EU, published on June 9, 2022 concludes that across all sites 0.2-0.3% of participants reported at least one serious adverse reaction after receiving the first and/or second dose, and similar numbers are reported after the first booster. (https://zenodo.org/record/6629551)

We are now hearing that the EU issued a warning that taking the boosters may cause adverse effects to the immune system and may not be warranted [44]. A top Israeli immunologist has called on the leaders at the Israeli Ministry of Health to admit that the mass vaccination campaign has failed in Israel [45]. The vaccine is in trial phase and has been linked to not only instant side effects but also short to medium-term side effects [44]. Thorp et al. (2022) highlighted just a few of these side effects, such as miscarriage, foetal death and malformation, chronic autoimmune disease, permanent immune deficiency syndrome, chronic permanent CNS diseases and chronic cognitive disorders, seizure disorders and neonatal/infant cancers; and this only refers to foetuses and infants [46]. Not enough time has passed since administration of the first injections to know what the long-term effects might be.

Pfizer's documents show lipid nanoparticles with their mRNA cargo being distributed throughout the entire body and passing through the blood brain, placental and foetal blood brain barriers and concentrate in the ovaries. From US life insurance reports we know that the all-cause death rates were up 40% in ages 18-64 years by the end of Q3 2021, and according to life insurance companies there are 100,000 excess deaths per month in the US in all age groups, which cannot be attributed to COVID-19 alone [46].

In a recently published study by Doshi et al from August [47], the authors looked for serious adverse events (SAE) and adverse events of special interest (AESI) in the randomized phase III trials of both Pfizer and Moderna. Because both companies began unblinding study participants and offering them the vaccines only weeks after the emergency use authorization was granted by the FDA, the interim datasets from the time point of the EUA was used. By looking in depth at the total number of SAE instead of only the number of participants reporting one or more SAE, they found that the Pfizer injection was associated with a 36% higher risk of SAE in the vaccine versus the placebo group, while the Moderna vaccine was associated with a 6% increase of SAE in the vaccine group. They concluded after a simple risk-benefit analysis using the companies' own data, that for both Pfizer and Moderna excess risk of serious AESI exceeded the benefit of reduction in Covid-19 hospitalizations. They finish with a request for full transparency of the Covid-19 vaccine clinical trial data which to this day are inaccessible.

In a study by Shimabukuro et al. [48] following 3,958 pregnant participants in the v-safe pregnancy registry only 827 (20.89%) women enrolled in the study completed pregnancy. In the v-safe table the number of pregnant women registered as pregnant was 30,887 and the number registered as pregnant after vaccination with either Moderna or Pfizer vaccine was 4,804, which suggests loss of pregnancy and stillbirths in 84.45% of the pregnant women [48].

In a study concentrating on the second booster dose by Regev-Yochay et al. (2022) breakthrough infections were shown to be common, mostly very mild, but with high viral loads [49]. The vaccine efficacy against infection was as low as 30% for BNT162b2 (Pfizer) and 11% for mRNA1273 (Moderna) with local and systemic adverse reactions reported for 80% of BNT162b2 recipients and 40% of mRNA1273 [50].

Children under 18 are 51 times more likely to die from the mRNA vaccines than from COVID-19 if unvaccinated. Young adults in the age range of 18 to 29 are eight times more likely to die from vaccination than from COVID-19. Adults from 30 to 39 are 7 times more likely to die from vaccination and those aged 40 to 49 are 5 times more likely to die after vaccination. People in the group aged 50 to 59 are still twice as likely to die after vaccination than after COVID-19. Only when over 60 years of age is the chance of death equal for both causes. Even when over 80 years old the likelihood of dying from Covid inoculation is just 0.13% lower than the risk of dying from the infection. The authors concluded that the protection from COVID-19 death falls far short of the risk of dying from the vaccine for people below 50 years old [51].

According to Kostoff [52] the number of deaths attributable to each inoculation is five times higher in the most vulnerable 65+ demographic than deaths attributable to COVID–19. With decreasing age, the risk of death from COVID-19 decreases drastically. Combined with the longer-term effects of the inoculations, most of which are still unknown, this increases the risk-benefit ratio, perhaps substantially, in the lower age groups.

A study looking at the length of protection over time indicated that immunity against the delta variant of SARS-CoV-2 waned in all age groups a few months after receiving the second dose of the vaccine [53]. Another study found that antibody titres increased significantly at five weeks after the first vaccination but decreased rapidly at four months after the second injection. This significant decrease was independent of gender or age [54]. The fact that immunity after vaccinations seems to wane over time has been reported by other researchers who also found that antibody titres are decreasing by up to 40% each months [55] with no detectable antibody levels recorded in 16.1% of the subjects in one study within six months. Therefore, booster vaccinations were recommended [56]. Another study found that decrease in neutralising antibody titres to alpha, beta, gamma and delta variants was not significantly different between the different vaccines. They used modelling and predicted below 50% protection against symptomatic infection within the first year, also urgently recommending booster shots [57]. Scientists agree though, that introducing a booster too early

and too frequently carries increased risks especially for vaccines that have immune-mediated side-effects, such as myocarditis, Guillaine-Barre syndrome and thrombosis [58].

Lui et al. [59] specifically looked at protection against Omicron and concluded that the Omicron variant of COVID-19 was remarkedly resistant to neutralization by serum from individuals vaccinated with one of the four widely used COVID-19 vaccines. Serum from persons vaccinated and boosted with mRNA-based vaccine was also showing substantially diminished neutralization of Omicron.

A study investigated the neutralizing antibody titres against the reference strain WA1/2020 and omicron subvariants BA.1, BA.2, BA.2.12.1 and BA.4 or BA.5. in participants that had been double vaccinated and boosted with the Pfizer mRNA vaccine versus participants that had been vaccinated (bar one) and infected with the BA.1 or BA.2 variant of omicron on average 29 days prior. Their conclusion was that compared to the reference strain neutralising antibody titres to the Omicron variants were substantially decreased in both groups (6.4, 7.0 and 14.1 times (vaccinated) and 6.4, 5.8 and 9.6 times (infected) lower against BA.1, BA.2, BA.2.12.1 respectively and 21.0 (vaccinate) and 18.7 (infected) times lower against BA.4 or BA.5), suggesting that the later variants increasingly escape neutralizing antibodies [60].

Even a fourth shot of a Covid-19 vaccine is "not good enough" to prevent Omicron, according to a preliminary study in Israel. Sheba Hospital tested a fourth shot given to more than 270 medical workers, with 154 getting the Pfizer jab and 120 receiving Moderna. The researchers found that both groups showed a "slight" increase in antibodies - but not sufficient to prevent Omicron. Disturbingly, the vaccinated infected health care workers had relatively high viral loads, which suggests that they were infectious [49].

In a letter to the editor Yamamoto (2022) sums up the literature pointing to the fact that 8 months after being vaccinated twice the immune functions are less than those of an unvaccinated person according to a study by Nordstroem et al (2022) [61]. Booster shots can impair immunity due to a variety of factors leading to the recommendation to discontinue further booster shoots.

A paper by John Gibson from the University of Waikato looked at the excess death rate in New Zealand and found that rising excess mortality was closely related to the booster rollout. The author calculated 16 excess deaths for each 100,000 booster doses (https://repec.its.waikato.ac.nz/wai/econwp/2211.pdf).

According to the Health NSW government site the data obtained in 14 days until 16th of July 2022 continues to show the trend of worsening effects after the booster shots. Figure 1 shows the hospitalisation, the ICU admission and deaths sorted by vaccination status with a total of 806, 77 and 142 respectively. Comparing data of people infected with COVID the figures provided by the NSW Health Department (Fig 1) seem to confirm this trend.

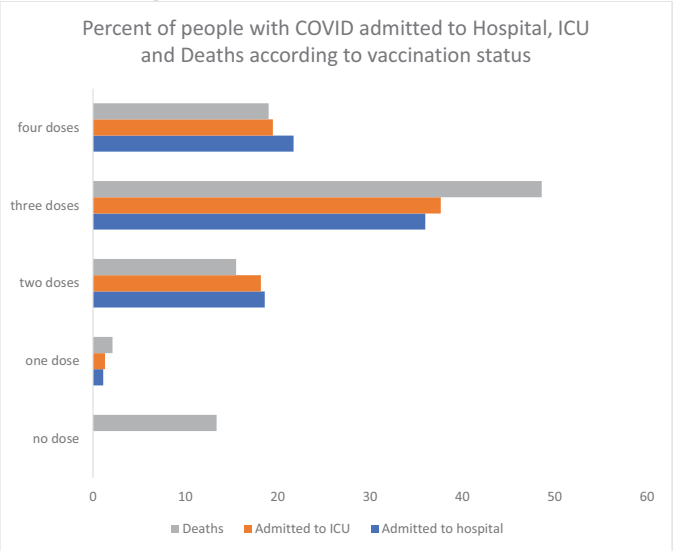

Figure 1: People diagnosed in 14 days up to the 16th of July 2022 who were submitted to hospital, ICU and died in New South Wales, Australia. Numbers represented as percentage of the total (https://www.health.nsw.gov.au/Infectious/covid-19/Documents/weekly-covid-overview-2-22-716.pdf)

Treatments

It is truly disturbing that treatments recommended by doctors in America, some of them having successfully treated COVID-19 patients, including very sick patients, have not been investigated in Australia. These treatments are mainly based on vitamins, zinc and zinc ionophores, such as ivermectin or hydroxychloroquine. The recommendation is to treat as early as possible. Scientific papers support the use of ivermectin according to Bryant et al. [62]. They found moderate to strong evidence that ivermectin can reduce COVID-19 deaths while being safe and inexpensive. The same was found for hydroxychloroquine in a review by McCullough et al, which also stated that a reduction of mortality strongly depends on an early start of the treatment. Hydroxychloroquine has been registered in the US since 1955 and has a well-characterized safety profile [63].

Yet here in Australia the recommendation is to isolate and monitor yourself. Only if you have difficulty breathing, experience loss of speech or mobility, confusion or chest pain should you contact the health care provider. Additionally, the government strongly advises not to use the following treatment for COVID-19 off label: Ivermectin, doxycycline, zinc and hydroxychloroquine (https://www.health.gov.au/health-alerts/covid-19/treatments).

The TGA provisionally approved the first oral treatments in January 2022 for Australia, Lagevrio® (molnupiravir) and Paxlovid® (nirmatrelvir + ritonavir) and recommend that both treatments should be started as soon as possible after diagnosis of COVID-19 (https://www.health.gov.au/health-alerts/covid-19/treatments/oral). The TGA also accepted - similar to the agreement for the

provisionally approved vaccines - rolling data for COVID-19 treatments, to enable early evaluation of data as it comes to hand (https://www.tga.gov.au/apm-summary/lagevrio). In other words, both drugs have been provisionally approved on the basis of short-term efficacy and safety data and permanent approval depends on the efficacy and safety data from ongoing clinical trials and post-marketing assessment. (https://www.ebs.tga.gov.au/ebs/picmi/picmirepository.nsf/pdf?OpenAgent&id=CP-2022-PI-01049-1)

Therefore, these treatments are still in trial phase and all patients treated with them are trial participants. Paxlovid has listed numerous potential complex and serious drug-drug interactions against its registration which could result in severe or life-threatening side effects(https://www1.racgp.org.au/newsgp/clinical/what-gps-need-to-know-about-the-new-covid-antivira).

Short Term Side Effects

Just to name a few short-term side effects: Death, Cardiac disorders such as Myocarditis, Blood and lymphatic system disorders, such as blood clots, thrombocytopenia, low platelet count, cerebral venous sinus thrombosis, capillary leakage syndrome, Congenital and genetic disorders, Eye disorders, Immune disorders, Muscular, skeletal and connective tissue disorders, Cancerous tumours, Nervous system disorders, Pregnancy and perinatal conditions, Guillain-Barre syndrome and the list goes on.

Pfizer's documents demonstrate lipid nanoparticles with their mRNA cargo being distributed to the entire body and pass through the blood brain, placental and foetal blood brain barriers and concentrate in the ovaries. The vaccine is in trial phase and has been linked to not only instant but also long-term side effects.

Thorp et al. [46] highlighted just a few of the side effects, such as miscarriage, foetal death and malformation, chronic autoimmune disease, permanent immune deficiency syndrome, chronic permanent CNS diseases and chronic cognitive disorders, seizures and neonatal/infant cancers; and this is only with regard to foetuses and infants.

The data from NSW (Figure 1) showed clearly that COVID injections were correlated with increases in hospitalization and ICU admissions and indicate a relation to death with COVID injections. The increase in hospitalisation, ICU admissions and deaths is very pronounced after the third injection although only 69% of the population took the booster shot versus 95% taking the initial series.

The Australian Bureau of statistics has just released the national death rate for March 20, 2021 up until 31 March 2022 (registered by 31 May 2022) as 44,331, which according to their own statement lies 6,609 (17.5%) above the historical average. These extra deaths cannot be explained by COVID alone (Fig 2) which is responsible for less than half of the excess deaths in the first 4 months of 2022 in Australia. Cancer, diabetes and neurodegenerative diseases are all above the baseline in this time frame (https://www.abs.gov.au/statistics/health/causes-death/provisional-mortality-statistics/latest-release?fbclid=IwAR3fpywSvxWCXTRUaZx99M6s_w_kBRdMa3b_13msQ3bNPRanFjGHi-wWTZQ).

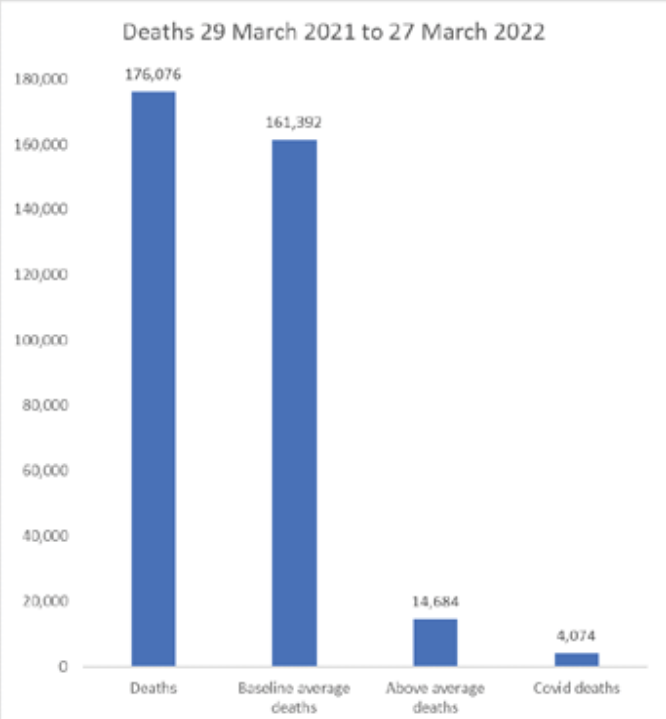

Figure 2: Death rate for Australia from 20th of March 2021 to 27 March 2022 according to the Australian Bureau of Statistics (https://www.abs.gov.au/statistics/health/causes-death/provisional-mortality-statistics/latest-release?fbclid=IwAR3fpywSvxWCXTRUaZx99M6s_w_kBRdMa3b_13msQ3bNPRanFjGHi-wWTZQ)

We get an insight into what is really going on in England where the government released COVID related death data (if the death certificate mentioned COVID) and all other death data sorted by vaccination status (Figure 3). The overall death rate for the unvaccinated was 17% while for the vaccinated it was 83%. The trend seems to be an ever increasing all causes death rate with added vaccinations without getting any protection from additional injections.

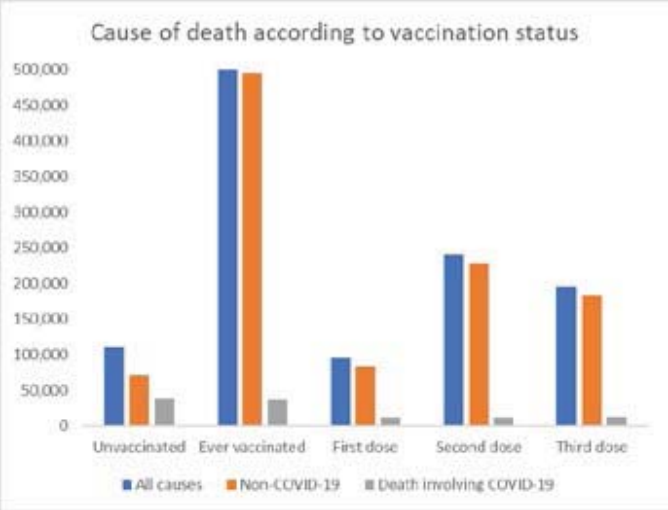

Figure 3: The cause of death according to vaccine status in the UK from the 1 January 2021 to the 31 May 2022 https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/deathsbyvaccinationstatusengland

Unexplained deaths in Germany have been shown to be the consequence of mRNA vaccines causing an autoimmune response of CD8 T killer lymphocytes in all organ systems throughout the body. Dr Sucharit and Dr Burkhardt stated that the mRNA vaccine is killing the young and the old (https://doctors4covidethics.org/on-covid-vaccines-why-they-cannot-work-and-irrefutable-evidence-of-their-causative-role-in-deaths-after-vaccination/).

According to the VAERS database over 22,000 deaths have been associated with the COVID-19 vaccine. This is particularly alarming as according to the VAERS website adverse events including deaths are underreported by an unknown factor which could be between 10 and 100, so the actual number of deaths is likely much higher and could be over a million.

From large insurance companies in the US we know that the all-cause death rates are up 40% in ages 18-64 years and there are 100,000 excess deaths per month in the US across all age groups, which cannot be attributed to COVID-19 alone. However, caution has to be taken in interpreting these data as deaths due to suicides and delayed hospital treatment are not taken into consideration. Nevertheless, the trend seems to be the same and should raise alarm.

A study by Gat et al. on semen of male semen donors revealed a transient decrease in semen concentration and a reduction in the total motile count (TMC) after COVID-19 vaccination [64].

In January 2022 the "Save us now" organisation put together a list of 1011 case studies reporting side effects after vaccination (Table 1) (https://www.saveusnow.org.uk/covid-vaccine-scientific-proof-lethal/). Most of these side effects have not been listed in any of the vaccine brochures or on the Australian Government websites. Knowing that the mRNA vaccine can be found in nearly all organs including the brain the involvement of so many organs and tissues is not surprising. The explanation for multiple disorders and multiple affected organs post-vaccination is the toxicity of the S1 subunit of the spike protein which creates similar symptoms as the viral disease. Additionally, the lipid nanoparticles alone cause inflammation and vascular damage [65].

Table 1 A and B: All symptoms reported from the 1011 case studies listed by the "Save us now organisation" and some additional case studies by Di Mauro et al. [66]; Erro et al. [67]; Garreffa et al. [68]; Jabagi et al. [69] and Jee-Eun et al. [70] https://www.saveusnow.org.uk/covid-vaccine-scientifc-proof-lethal/

A

System organ class	Vaccine-induced SE	Pfizer/ BioNTech	Moderna	Oxford/ Astra Zeneca	Johnson & Johnson
Auditory and balance disorders	Acute vertigo [71]	x			
	Sudden sensorineural hearing loss			x	
Autoimmune disease	Autoimmune encephalitis			x	
	Autoimmune hepatitis	x	x	x	
	Graves' disease	x			
	Limbic encephalitis	x			
	Multiple sclerosis	x	x	x	
	Myasthenia gravis	x			
	Psoriasis	x		x	

	Severe autoimmune hemolytic anemia		x		
	Systemic lupus erythematosus	x			
	Vogt-Koyanagi-Harada Syndrome	x		x	
Cardiac disorders	Arrhythmia		x		
	Cardiac tamponade	x			
	Cardiomyopathy	x			
	Endocarditis		x		
	Kounis hypersensitivity-associated acute myocardial infarction	x			
	Myocardial infarction	x	x	x	
	Myocarditis *	x	x	x	x
	Myocarditis-induced Sudden Death	x			
	Myopericarditis	x	x		
	Pericarditis	x	x	x	x
	Takotsubo cardiomyopathy	x	x	x	
	Transient Cardiac Injury	x			
Death		x	x	x	x
Dermal disorders	Chilblains	x	x		
	Delayed adverse skin reactions *2	x	x	x	
	Dermal hypersensitivity (Covid arm)	x	x	x	
	Exacerbated Hailey-Hailey	x	x		
	Petechiae and peeling of fingers	x	x		
	Purpuric rash *1	x	x	x	
	Reactivation of alopecia areata	x		x	
	Reactivation of Bacille Calmette-Guérin scar	x	x		
	Sweet's syndrome	x		x	x
	Toxic epidermal necrolysis			x	
Endocrine disorders	Menstrual disorders, heavy menstrual bleeding	x	x	x	x

Gastrointestinal disorder	Appendicitis	x			
	Gastroparesis	x			
	Oral aphthous ulcers	x			
Immune and Lymphatic disorders	Allergy to PEG-ASNase	x	x		
	Anaphylaxis *4	x	x	x	
	Antibody-dependent cell cytotoxicity			x	x
	Arthritis	x			
	Complement-dependent cytotoxicity			x	x
	Hemophagocytic lymphohistiocytosis			x	
	Immune-mediated disease outbreaks	x	x	x	
	Lymphadenopathies *3	x	x	x	
	Multisystemic inflammatory syndrome	x		x	
	Rapid Progression of Angioimmunoblastic T Cell Lymphoma	x			
	Seronegative Polyarthritis	x		x	
	Splenic infarction			x	
	Thymic hyperplasia		x		
Infections	Covid-19	x	x	x	x
	Herpes Simplex	x	x	x	
	Herpes Zoster (Shingles)	x	x	x	
	Hepatitis C reactivation	x			
	Non-disseminated herpes zoster	x			
Liver and gallbladder disorders	Acute liver injury		x		
	ANCA glomerulonephritis		x		
Musculosceletal disorders	Amyotrophic neuralgia			x	
	Fasciitis		x		
	Myositis (inflammatory)	x		(x)	
	Polyarthralgia and Myalgia Syndrome			x	
	Polymyalgia rheumatica	x		x	

	Rhabdomyolysis	x	x		
	Still's disease			x	
	Synovitis	x			

*Acute Fulminant Myocarditis and Cardiogenic Shock, lymphocytic, eosinophilic, infarct-like and autoimmune myocarditis, acute haemorrhagic encephalomytitis [72].

*1 Haemorrhagic rash, Cutaneous thrombosis
*2 Eczematous, Shingles-like skin lesion, Pityriasis rosea-like reaction, Urticaria, Lichen planus-like dermatitis, Bullous drug eruption, Pruritus, Spongiotic dermatitis, Morbiliform rash, Papulovesicular reaction, Purpura annularis telangiectodes
*3 Cervical lymphadenopathy, Axillary lymphadenopathy (Garreffa et al, 2021), [68]
*4 Prolonged anaphylaxis, biphasic anaphylaxis, Anaphylactoid reaction and coronary thrombosis

B

System organ class	Vaccine-induced SE	Pfizer/ BioNTech	Moderna	Oxford/ Astra Zeneca	Johnson & Johnson
Neurological disorders	Acute inflammatory neuropathies	x	x	x	
	Abducens Nerve Palsy	x			
	Adrenomyeloneuropathy				
		x			
	Bell's palsy	x	x	x	
	Cerebral hemorrhage *8	x	x	x	x
	Cerebral venous sinus thrombosis	x	x	x	x
	Cerebral venous sinus thrombosis (CVST) with thrombocytopenia				x
	CNS demyelination	x	x	x	x
	CNS inflammation	x	x		
	Distal small fiber neuropathy			x	
	Encephalomyelitis *5	x		x	
	Encephalopathy (acute)	x	x		
	Guillain-Barré syndrome (Jee-Eun, 2022)	x	x	x	x
	Miller-Fisher syndrome	x		x	
	Myelitis *9	x	x	x	
	Neuro-ophthalmic complications with VITT			x	
	Optic neuritis	x			
	Parsonage-Turner Syndrome	x	x		
	Stroke (Jabag et al, 2021) *6	x	x	x	x
	Status epilepticus, seizures*7	x	x	x	
Olfactory disorders	Phantosmia	x			

Optical disorders	Acute corneal endothelial graft rejection	x			
	Bilateral choroiditis			x	
	Central Serous Chorioretinopathy	x			
	Diplopia			x	
	Immune mediated keratolysis			x	
	Macular Neuroretinopathy			x	
	Oculomotor palsy			x	
	Retinal necrosis due to varicella zoster reactivation	x			
	Transient visual field loss	x			
	Tolosa-Hunt syndrome	x			
	Uveitis, Panuveitis	x			
Other disorder	Pancreas allograft rejection			x	
	Pancreatitis	x			
Pregnancy outcomes	Miscarriage (Pfizer's own data)	x			
Psychiatric disorder	Depression			x	
Pulmonary disorder	Acute eosinophilic pneumonia			x	
	Squamous cell carcinoma of the lung with hemoptysis	x			
Renal and urinary disorders	Acute renal failure		x		
	Crescentic Pauci-Inmune glomerulonephritis	x	x		
	Genital necrosis with cutaneous thrombosis	x			
	IgA nephropathy	x	x		
	Lipschuetz ulcer			x	
	Nephrotic syndrome			x	x
	Macroscopic hematuria	x	x		
	Minimal change disease and acute kidney injury	x		x	
Respiratory and thoratic disorders	Asthma exacerbation	x			
	Pulmonary embolism	x	x	x	x
	Semi Occluded Vocal Tract			x	
	Vaccine-induced interstitial lung disease	x			
Tissue disorders	Hemophagocytic lymphohistiocytosis			x	

Vascular disorders	Accelerated hypertension				
	Diffuse prothrombotic syndrome			x	
	Fatal systemic capillary leak syndrome			x	
	Giant cell arteritis	x			
	Haemolysis	x		x	
	Haemorrhage *10	x	x	x	
	Inflammation and platelet activation			x	x
	Limb ischemia			x	
	Microscopic polyangiitis	x			
	Symptomatic carotid occlusion				x
	Thrombocytopenia *11	x	x	x	x
	Thromboembolic events *12	x	x	x	
	Thrombotic events *13	x	x	x	x
	Vasculitis *14	x	x	x	x

*5 Acute disseminated Encephalomyelitis, acute demyelinating Encephalomyelitis, acute haemorrhagic encephalomyelitis (Ancau et al, 2022) [72]

*6 Ischemic stroke, acute ischemic stroke and hemorrhage, haemorrhagic stroke

*7 Acute hemichorea-hemiballismus, Dyskinesia (Erro et al, 2021) [67]

*8 Intracerebral hemorrhage and thrombocytopenia, Intracerebral hemorrhage associated with vaccine-induced thrombotic thrombocytopenia

*9 Extensive longitudinal transverse myelitis, Transverse myelitis, acute transverse myelitis, partial transverse myelitis, Myelitis, Acute bilateral optic neuritis/chiasm with longitudinal extensive transverse myelitis, Neuromyelitis optica (Devic's disease)

*10 Acral hemorrhage, Pulmonary hemorrhage, Retinal haemorrhage, Lobar hemorrhage with ventricular rupture

*11 Thrombotic thrombocytopenia, Thrombocytopenia and splanchnic thrombosis, Thrombotic thrombocytopenic purpura, Immune thrombocytopenic purpura

*12 Venous thromboembolism and mild thrombocytopenia

*13 Arterial thrombosis, Cerebral venous sinus thrombosis, Both transverse sinuses thrombosis, Left sigmoid sinus thrombosis, Portal vein thrombosis, Bilateral superior ophthalmic vein thrombosis, Major artery thrombosis, Idiopathic external jugular vein thrombophlebitis, Disseminated intravascular coagulation, Ophthalmic vein thrombosis, Central retinal vein occlusion

*14 Cutaneous vasculitis, Leukocytoclastic vasculitis, Small-vessel vasculitis, Granulomatous vasculitis, Vasculitis and bursitis, ANCA-associated vasculitis, Urticarial vasculitis, Neutrophil anti-cytoplasmic antibody-associated vasculitis, Cutaneous leukocytoclastic vasculitis

Side Effects (SE) are listed by organ class in alphabetical order, not by severity. To keep these tables manageable, we sorted subclasses of specific side effects under one heading and the foot notes below explain which subclasses can be found under the listed SE. Note that not all subclasses of SE have been demonstrated for all 4 vaccines.

COVID-19 vaccines cause more side effects than any other vaccine, a fact that is attributed to its interactions with the immune system. Not only does spike protein produces unwanted side effects, but mRNA and nanoparticles do as well. Seneff et al [15] enumerated Covid-19 vaccine effects on the innate immune system, importantly a decrease of type I interferon signalling, as well as disturbances in the regulation of protein synthesis affecting the formation of immune cells and the apoptosis of tumor cells. These are major disturbances that in turn can lead to a multitude of disorders such as those listed in Table 1. The suppression of the interferon response by the mRNA vaccines alone can lead to a wide variety of disorders, such as reactivation of viral infections and reduce the immune system's ability to not only fight disease but to keep tumors and autoimmune reactions suppressed [73]. A case report by Glas et al from [74] illustrates the effects of a disseminated viral infection on an immune-suppressed patient: In this instance fatal multiorgan failure associated with disseminated Herpes simplex virus-1 infection. Considering that reactivation and spread of dormant viral infections including Herpes simplex and Herpes zoster are listed as side effects from both mRNA injections as well as the Astra Zeneca vaccine, it is maybe not surprising that pathology reports by Dr Sucharit and Dr Burkhardt (2021) show multiorgan failure as cause of death in several cases of post-vaccine deaths.

Spike proteins enter the circulation when the cell they were attached to is destroyed by the immune system. The freely circulating spike proteins attach to any cell that expresses ACE2 receptors, explaining the multitude of sites where disorders occur [75]. Another method of viral spread that escapes the immune system is the formation of syncytia which can be induced by the spike protein itself. Heterotypic cell-in-cell structures with lymphocytes inside multinucleate syncytia are prevalent in the lung tissues of coronavirus disease 2019 (COVID-19) patients. This membrane fusion is dictated by a bi-arginine motif within the polybasic S1/S2 cleavage site leading to the formation of multinucleate syncytia. Host metalloproteases (ADAM-17 and ADAM-10) promote such spike protein-mediated lung cell fusion [76, 77]. Pepe et al (2022) [77] showed furthermore that the formation of tunneling nanotubes can be induced by Covid-19 in a so far undisclosed way and used to transport viral particles or indeed viral components like S and N proteins from infected to ordinarily non-permissive cells, e.g. neuronal cells. There are multiple ways in which the virus and the spike protein can spread throughout the body and from cell to cell without attracting too much attention from the immune system. Further weakening of the immune system through rashly promoted genetic intervention can only lead to more severe disease.

What needs to be further emphasised is that the majority of deaths with and from COVID- 19 occur in the elderly with multiple co-morbidities and generally weaker immune systems. Yet they are vaccinated with an injection that amplifies underlying disorders (Fig 4) and is dependent on a strong immune response. Ironically, the survival of many of those patients is probably due to their immune system not being able to mount a significant response to the induced spike protein production.

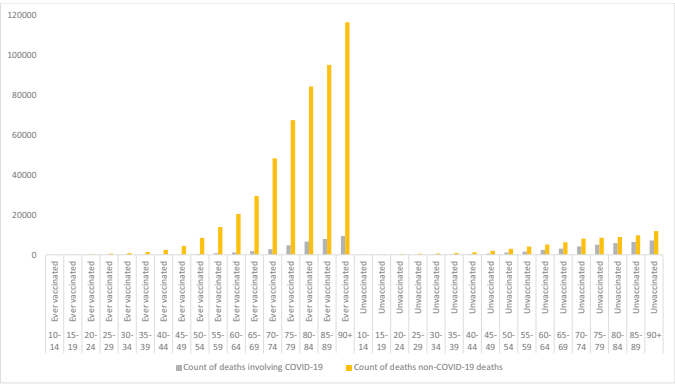

Figure 4: Death rate due to COVID and other causes comparing the vaccinated (at least one vaccination) and unvaccinated in each age group. The data of deaths occurring was for the period of the 1st of January 2021 to 31st of May 2022 in England (https://www.ons.gov.uk/)

Long Term Side Effects

Long-term risks of vaccination as predicted by scientists, many already validated by scientists and doctors:

Vaccine-induced autoimmunity, pathogenic priming, multisystem inflammatory disease and autoimmunity, antibody dependent enhancement (ADE), activation of latent viral infections, neurodegeneration and prion disease, increased thrombosis, cardiomyopathy and other vascular events following vaccination, babies suffering enduring adverse consequences, mRNA reverse transcribing intracellularly into the DNA and death due to autoimmune disease long after vaccination [78-84].

Some More Details

Autoimmune Disease

A study by Lyons-Weiler [79] revealed that over 1/3 of SARS CoV-2 proteins, including the spike protein show problematic homology to key proteins in the human adaptive immune system which might lead to autoimmune reactions against these proteins. Kelleni [78] reports on the potential risk of the vaccine to induce auto-immune diseases such as thrombocytopenia, myocarditis and immune induced thrombosis and thromboembolism which can have fatal outcomes and might be behind some of the post vaccination reports on sudden deaths.

Antibody Dependent Enhancement (ADE)

Hasan et al. [80] analysed data from the National Health Service published by Public Health England and showed that the death rate due to the Delta variant infection was eight times higher in fully vaccinated than in unvaccinated infected people. The authors suggest that in a subset of individuals the pre-existing anti-S-IgG titre induced by vaccination may be sub-neutralizing and leading to accelerated infectivity via ADE, which is displayed as higher death rates.

Prion Disease

The potential risk factors of the mRNA or vector DNA vaccine are protein sequences that can induce TDP-43 and FUS to aggregate into prion configuration, which might lead to neurodegenerative diseases, such as Alzheimers [85]. The spike protein encoded by the mRNA binds to the ACE2 receptor which releases zinc molecules. Zinc also causes TDP-43 to transform into a pathological prion [81]. The link with neurodegenerative disease is the ability of the spike protein to interact with the heparin binding amyloid forming proteins. A study indicated that the S1 protein forms a stable bond with the aggregation-prone proteins, which might initiate aggregation of brain proteins and thereby accelerate neurodegeneration [82]. Finisterer and Scorza [86] further stated that SARS-CoV-2 vaccines trigger neurological adverse reactions and both mild and severe neurological side effects have been occasionally reported. Studies support the theory that the onset and progression of neurodegenerative diseases such as Alzheimer and Parkinson disease, including TDP-43 proteinopathy, are associated with propagation of protein aggregates between neuronal cells. These speculations are supported by a case report of prion disease due to vaccination from Turkey [87, 88].

Thrombosis, Capillary Leakage Syndrome and Myocarditis

Scientific studies have raised serious concerns about the safety of AstraZeneca after reports of cerebral venous sinus thrombosis and a variety of other thrombotic events the AstraZeneca vaccination with studies reporting such events in medical journals. Kircheis [22] reported that other serious conditions have been reported for COVID vaccines such as capillary leakage syndrome

(AstraZeneca) and coronary myocarditis (Pfizer).

Pregnancy and Vaccination

Some concerns about vaccinating pregnant women were voiced by Anand and Stahel [83]. Walsh et al. [89]. reported that the results of the Pfizer vaccine demonstrate a broad immune response to vaccination with stimulation of neutralizing antibody responses, stimulation of CD4+ cells and growth of effector memory CD8+T cells in men and women. Anand and Stahel [83] hypothesised that one could assume this would also happen in pregnant women. This would not be favourable for a perinatal outcome and might lead to preterm birth and fetal loss, as a good outcome relies on amplifcation of helper T cell type 2 and regulatory T cell activity coupled with decreased Th1 response [90]. Evidence has suggested that mothers with variant CD4+ T cell responses give birth to babies that may suffer enduring adverse consequences [91].

Side Effects Acknowledged but Played Down as Extremely Small Risk

The TGA report in Australia on a weekly basis and the report of the 2nd of September 2021 mentioned nine more blood clots and low platelet counts, confirmed as probably Thrombocytopenia syndrome linked to the AstraZeneca vaccine with two connected deaths during that week, one from Queensland and one from NSW. An assessment of the 125 cases of thrombosis with thrombocytopenia syndrome (TTS) showed that women in the younger age groups were slightly more likely to develop TTS in more unusual places such as brain and abdomen with more serious outcomes projected (TGA).

Another rare side effect is Guillian-Barre syndrome (GBS), which affects the nerves. Up to the 29 August 99 reports of GBS after vaccination have been received. Further 61 reports of immune thrombocytopenia were lodged after AstraZeneca vaccination. For the Pfzer vaccine the TGA reports 293 instances of suspected myocarditis and/or pericarditis following vaccination to the 29 August 2021. Nine of these reports were from children 16 to 17 years of age. A study concluded that observations of increased thrombosis, cardiomyopathy and other vascular events following vaccination might be caused by the mRNA vaccines dramatically increasing inflammation of the endothelium and T cell infiltration of cardiac muscle [92].

Whistleblowers

At a parliament enquiry by US senator Ron Johnson lawyer Thomas Renz presented three US military doctors, Drs. Samuel Sigoloff, Peter Chambers, and Theresa Long, whose declarations he planned to use in federal court under penalty of perjury. These doctors revealed a 300% increase in miscarriages in the military above the five-year average in 2021 with the five-year average being 1,499 miscarriages per year while in the first 10 months of 2021 the registered miscarriages were 4,182. Other diseases went up in a similar fashion such as an almost 300% increase in cancer diagnoses (from a five-year average of 38,700 per year to 114,645 in the first 11 months of 2021). Neurological issues increased by 1000% from a baseline average of 82,000 to 863,000 in 2021. Some other increased conditions were:

- 269% increase of myocardial infarction
- 291% increase of Bell's palsy
- 156% increase of children's congenital malformations of military personnel
- 471% increase of female infertility
- 467% increase of pulmonary embolisms

https://newlifenarrabri.wordpress.com/2022/02/01/jo-nova-huge-spike-in-us-military-injuries-from-covid-vaccinations/ and https://www.ronjohnson.senate.gov/2022/2/sen-johnson-to-secretary-austin-has-dod-seen-an-increase-in-medical-diagnoses-among-military-personnel

According to an interview in February 2022 with Julian Gillespie, who is currently fighting in court against the vaccine mandates, an evaluation of the TGA reports revealed that Australia's average of adverse events after vaccination since 1971 up to 2020 is recorded as 2.4 death per year and up to 3,500 adverse events per annum. Since the rollout of the COVID vaccines there have been 755 deaths and 105,000 adverse events in a year with these figures likely to be underreported. https://rumble.com/vtv5pe-julian-gillespie-update-on-avn-judicial-review-to-stop-vaccines-in-australi.html?fbclid=IwAR34RTAAYX_nf9eTe1LOJSxuZ0-TbUFasXPQ37qhPEqrQI9wNe8Yig4ZwQ8

The question is how many deaths and side effects are we accepting as normal for vaccines and where do we draw the line to say more investigations need to be done before any further vaccines are distributed?

Conclusion

Never in Vaccine history have 57 leading scientists and policy experts released a report questioning the safety and efficacy of a vaccine [93]. They not only questioned the safety of the current Covid-19 injections, but were calling for an immediate end to all vaccination. Many doctors and scientists around the world have voiced similar misgivings and warned of consequences due to long-term side effects. Yet there is no discussion or even mention of studies that do not follow the narrative on safety and efficacy of Covid-19 vaccination.

In the USA, as Blaylock [94] states it very nicely, federal bureaucrats have forced the acceptance of special forms of care and prevention, which includes experimental mRNA vaccines [93]. Medical experts that have questioned the safety of these vaccines have been attacked and demonised, called conspiracy theorists and have been threatened to be de-registered if they go against the narrative. Alternative treatments were prohibited and people who never practised medicine are telling experienced doctors how to do their job. AHPRA is doing the same here in Australia to the detriment and in ignorance of science. When Adjunct Professor John Skerritt, who is currently the Deputy Secretary and directly responsibility for both the Therapeutic Goods Administration and the Office of Drug Control, was asked why the registration process for vaccines was shortened he wrote: "It is nonsense to assert that vaccines typically take 10 years to licence. The standard regulatory process for vaccines is about 10-12 calendar

months and in the case of COVID-19 vaccines this period was shortened by accepting data on a rolling basis, teams reviewing different parts of the dossier in parallel, working collaboratively with international regulators, and by many members of the teams working long hours" (personal e-mail communication). One has to wonder how they propose to assess long-term side effects. Can we really trust any pharmaceutical drug approval by the TGA after this statement?

Pfizer never planned to reveal its clinical trial data and had to be ordered by a judge in the USA to release the data to the public. Even then they and the CDC tried to limit the number of pages published per month which would have made the full study data public knowledge sometime in the 2070ies. The reason given was that some proprietary information had to be blacked out before release to the public. Again, it is inconceivable why it would be impossible to go through the study data in a few months, when it took the CDC less than 4 weeks to give the injections emergency use authorization - unless you want to entertain the idea that the study data were never actually read and scrutinised, a frightening perspective.

As scientists we put up hypotheses and test them using experiments. If a hypothesis is proven to be true according to current knowledge it might still change over time when new evidence comes to light. Hence, sharing and accumulating knowledge is the most important part of science. The question arises when and why this process of science has been changed. No discussion of new knowledge disputing the safety of the COVID-19 vaccines is allowed. Who gave bureaucrats the means to destroy the fundaments of science and tell scientists not to argue the science?

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ORIGINAL ARTICLE

SARS-CoV-2 Transmission among Marine Recruits during Quarantine

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ABSTRACT

BACKGROUND

The efficacy of public health measures to control the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has not been well studied in young adults.

METHODS

We investigated SARS-CoV-2 infections among U.S. Marine Corps recruits who underwent a 2-week quarantine at home followed by a second supervised 2-week quarantine at a closed college campus that involved mask wearing, social distancing, and daily temperature and symptom monitoring. Study volunteers were tested for SARS-CoV-2 by means of quantitative polymerase-chain-reaction (qPCR) assay of nares swab specimens obtained between the time of arrival and the second day of supervised quarantine and on days 7 and 14. Recruits who did not volunteer for the study underwent qPCR testing only on day 14, at the end of the quarantine period. We performed phylogenetic analysis of viral genomes obtained from infected study volunteers to identify clusters and to assess the epidemiologic features of infections.

RESULTS

A total of 1848 recruits volunteered to participate in the study; within 2 days after arrival on campus, 16 (0.9%) tested positive for SARS-CoV-2, 15 of whom were asymptomatic. An additional 35 participants (1.9%) tested positive on day 7 or on day 14. Five of the 51 participants (9.8%) who tested positive at any time had symptoms in the week before a positive qPCR test. Of the recruits who declined to participate in the study, 26 (1.7%) of the 1554 recruits with available qPCR results tested positive on day 14. No SARS-CoV-2 infections were identified through clinical qPCR testing performed as a result of daily symptom monitoring. Analysis of 36 SARS-CoV-2 genomes obtained from 32 participants revealed six transmission clusters among 18 participants. Epidemiologic analysis supported multiple local transmission events, including transmission between roommates and among recruits within the same platoon.

CONCLUSIONS

Among Marine Corps recruits, approximately 2% who had previously had negative results for SARS-CoV-2 at the beginning of supervised quarantine, and less than 2% of recruits with unknown previous status, tested positive by day 14. Most recruits who tested positive were asymptomatic, and no infections were detected through daily symptom monitoring. Transmission clusters occurred within platoons. (Funded by the Defense Health Agency and others.)

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Prospective studies may be useful to inform strategies to mitigate the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), particularly in group settings among young adults.[1-4] U.S. Department of Defense installations have implemented recommended public health interventions.[5] However, confined living spaces, close contact among persons during training regimens and other activities, shared dining facilities, and mixing of persons from across the United States place military populations at risk for contracting contagious respiratory infections such as coronavirus disease 2019 (Covid-19).[6-9] The transmission of SARS-CoV-2 and Covid-19 in military settings has not been well studied.

The public health program implemented by the U.S. Marine Corps for all new recruits includes a period of home quarantine followed by a 2-week, strictly supervised quarantine at a closed campus, with the objective of mitigating infection among recruits. To evaluate the effectiveness of these measures, we monitored SARS-CoV-2 infections with serial real-time quantitative polymerase-chain-reaction (qPCR) assays and assessed events of virus transmission by means of phylogenetic analysis of viral genomes obtained from infected participants.

METHODS

STUDY DESIGN AND PARTICIPANTS

To reduce the risk of introducing SARS-CoV-2 into basic training at Marine Corps Recruit Depot, Parris Island, in South Carolina, the Marine Corps established a 14-day supervised quarantine period at a college campus used exclusively for this purpose. Potential recruits were instructed to quarantine at home for 2 weeks immediately before they traveled to campus. At the end of the second, supervised quarantine on campus, all recruits were required to have a negative qPCR result before they could enter Parris Island. Recruits were asked to participate in the COVID-19 Health Action Response for Marines (CHARM) study, which included weekly qPCR testing and blood sampling for IgG antibody assessment.

After potential recruits had completed the 14-day home quarantine, they presented to a local Military Entrance Processing Station, where a medical history was taken and a physical examination was performed. If potential recruits were deemed to be physically and mentally fit for enlistment, they were instructed to wear masks at all times and maintain social distancing of at least 6 feet during travel to the quarantine campus. Classes of 350 to 450 recruits arrived on campus nearly weekly. New classes were divided into platoons of 50 to 60 recruits, and roommates were assigned independently of participation in the CHARM study. Overlapping classes were housed in different dormitories and had different dining times and training schedules.

During the supervised quarantine, public health measures were enforced to suppress SARS-CoV-2 transmission (Table S1 in the Supplementary Appendix, available with the full text of this article at NEJM.org). All recruits wore double-layered cloth masks at all times indoors and outdoors, except when sleeping or eating; practiced social distancing of at least 6 feet; were not allowed to leave campus; did not have access to personal electronics and other items that might contribute to surface transmission; and routinely washed their hands. They slept in double-occupancy rooms with sinks, ate in shared dining facilities, and used shared bathrooms. All recruits cleaned their rooms daily, sanitized bathrooms after each use with bleach wipes, and ate preplated meals in a dining hall that was cleaned with bleach after each platoon had eaten. Most instruction and exercises were conducted outdoors. All movement of recruits was supervised, and unidirectional flow was implemented, with designated building entry and exit points to minimize contact among persons. All recruits, regardless of participation in the study, underwent daily temperature and symptom screening. Six instructors who were assigned to each platoon worked in 8-hour shifts and enforced the quarantine measures. If recruits reported any signs or symptoms consistent with Covid-19, they reported to sick call, underwent rapid qPCR testing for SARS-CoV-2, and were placed in isolation pending the results of testing.

Instructors were also restricted to campus, were required to wear masks, were provided with preplated meals, and underwent daily temperature checks and symptom screening. Instructors who were assigned to a platoon in which a positive case was diagnosed underwent rapid qPCR testing for SARS-CoV-2, and, if the result was positive, the instructor was removed from duty. Recruits and instructors were prohibited from interacting with campus support staff, such as janitorial and food-service personnel. After

each class completed quarantine, a deep bleach cleaning of surfaces was performed in the bathrooms, showers, bedrooms, and hallways in the dormitories, and the dormitory remained unoccupied for at least 72 hours before reoccupancy.

Within 2 days after arrival at the campus, after recruits had received assignments to platoons and roommates, they were offered the opportunity to participate in the longitudinal CHARM study. Recruits were eligible if they were 18 years of age or older and if they would be available for follow-up. The study was approved by the institutional review board of the Naval Medical Research Center and complied with all applicable federal regulations governing the protection of human subjects. All participants provided written informed consent.

PROCEDURES

At the time of enrollment, participants answered a questionnaire regarding demographic characteristics, risk factors for SARS-CoV-2 infection, symptoms within the previous 14 days, and a brief medical history; blood samples and mid-turbinate nares swab specimens were obtained for qPCR testing to detect SARS-CoV-2. Demographic information included sex, age, ethnic group, race, place of birth, and U.S. state or country of residence; information regarding risk factors included whether participants had used masks, whether they had adhered to self-quarantine before arrival, their recent travel history, their known exposure to someone with Covid-19, whether they had flulike symptoms or other respiratory illness, and whether they had any of 14 specific symptoms characteristic of Covid-19 or any other symptoms associated with an unspecified condition within the previous 14 days.

Study participants were followed up on days 7 and 14, at which time they reported any symptoms that had occurred within the past 7 days. Nares swab specimens for repeat qPCR assays were also obtained. Participants who had positive qPCR results were placed in isolation and were approached for participation in a related but separate study of infected recruits, which involved more frequent testing during isolation. All recruits who did not participate in the current study were tested for SARS-CoV-2 only at the end of the 2-week quarantine, unless clinically indicated (in accordance with the public health procedures of the Marine Corps). Serum specimens obtained at enrollment were tested for SARS-CoV-2–specific IgG antibodies with the use of the methods described below and in the Supplementary Appendix.

Participants who tested positive on the day of enrollment (day 0) or on day 7 or day 14 were separated from their roommates and were placed in isolation. Otherwise, participants and nonparticipants were not treated differently: they followed the same safety protocols, were assigned to rooms and platoons regardless of participation in the study, and received the same formal instruction.

LABORATORY METHODS

The qPCR testing of mid-turbinate nares swab specimens for SARS-CoV-2 was performed within 48 hours after collection by Lab24 (Boca Raton, FL) with the use of the TaqPath COVID-19 Combo Kit (Thermo Fisher Scientific), which is authorized by the Food and Drug Administration. Specimens obtained from nonparticipants were tested by the Naval Medical Research Center (Silver Spring, MD). Specimens were stored in viral transport medium at 4°C. The presence of IgG antibodies specific to the SARS-CoV-2 receptor-binding (spike) domain in serum specimens was evaluated with the use of an enzyme-linked immunosorbent assay, as previously described,[10] with some modifications. At least two positive controls, eight negative controls (serum specimens obtained before July 2019), and four blanks (no serum) were included in every plate. Serum specimens were first screened at a 1:50 dilution, followed by full dilution series if the specimens were initially found to be positive.

WHOLE-GENOME SEQUENCING AND ASSEMBLY

SARS-CoV-2 sequencing was performed with the use of two sequencing protocols (an Illumina sequencing protocol and an Ion Torrent sequencing protocol) to increase the likelihood of obtaining complete genome sequences. A custom reference-based analysis pipeline (https://github.com/mjsull/COVID_pipe) was used to assemble SARS-CoV-2 genomes with the use of data from Illumina, Ion Torrent, or both.[11]

PHYLOGENETIC ANALYSIS

SARS-CoV-2 genomes obtained from patients worldwide and associated metadata were downloaded from the Global Initiative on Sharing All Influenza Data EpiCoV database[12] on August 11, 2020 (79,840 sequences), and a subset of sequenc-

es was selected from this database with the use of the default subsampling scheme of Nextstrain software[13] with the aim of maximizing representation of genomes obtained from patients in the United States. Phylogenetic analyses of the specimens obtained from participants were performed with the v1.0-292-ga9de690 Nextstrain build for SARS-CoV-2 genomes with the use of default parameters. Transmission and outbreak events were identified on the basis of clustering of the SARS-CoV-2 genomes obtained from study participants within the Nextstrain phylogenetic tree, visualized with TreeTime.[14] A comparative analysis of mutation profiles relative to the SARS-CoV-2 Wuhan reference genome was performed with the use of Nextclade software, version 0.3.6 (https://clades.nextstrain.org/).

DATA ANALYSIS

The denominator for calculating the percentage of recruits who had a first positive result for SARS-CoV-2 by qPCR assay on each day of testing excluded recruits who had previously tested positive, had dropped out of the study, were administratively separated from the Marine Corps, or had missing data. The denominator for calculating the cumulative positivity rates included all recruits who had undergone testing at previous time points, including those who were no longer participating in the study. Only descriptive numerical results and percentages are reported, with no formal statistical analysis.

RESULTS

STUDY POPULATION

From May 12 to July 15, 2020, a total of 1848 of 3143 eligible recruits (58.8%) across nine recruit classes were enrolled in the CHARM study; 324 recruits were ineligible because they were 17 years of age. A total of 40 study participants (24 participants on day 7 and 16 participants on day 14) did not return for follow-up (Fig. 1). These participants either dropped out of the study, were removed from the quarantine campus for medical or administrative reasons, or were separated from the Marine Corps. Participants were from 45 states, mostly from the eastern United States and particularly from states with larger populations. A total of 133 participants (7.2%) were born outside the United States (in 1 of 64 foreign countries), 1672 (90.5%) were male, 176 (9.5%) were female, 463 (25.1%) identified as Hispanic, and 271 (14.7%) identified as Black. The mean age of the participants was 19 years (range, 18 to 31), and 1544 (83.5%) were 18 to 20 years of age. Of the 1813 participants who underwent serologic testing at enrollment, 105 (5.8%) had serum specimens that were positive for SARS-CoV-2–specific antibodies.

At the time of enrollment, 16 of 1847 participants (0.9%) tested by means of qPCR were positive for SARS-CoV-2; 5 of these participants also had positive IgG serologic results (Table 1). The 16 participants with positive qPCR results reported that they had self-quarantined at home for 14 days before their arrival, had had no exposure to anyone with flulike symptoms, had had no respiratory distress or known SARS-CoV-2 infection, and had not visited a health care facility during the previous 2 weeks.

POSITIVE RESULTS AND SYMPTOMS

Of the 1801 participants who had negative qPCR results at enrollment, 24 (1.3%) were positive on day 7; of these participants, 4 had positive IgG serologic results on day 0. On day 14, a total of 11 of 1760 (0.6%) of the previously negative participants tested positive; none of these participants were seropositive on day 0. Therefore, 35 participants who had had negative qPCR results within the first 2 days after arrival at the campus became positive during the supervised quarantine. Of the 51 total participants who had at least one positive qPCR test, 22 had positive tests on more than 1 day.

Symptoms in the week before or on the day of the first positive qPCR result were reported in 5 of these 51 (9.8%) positive participants on the formal study questionnaires (Table 1). The symptoms in these 5 participants were runny nose; runny nose, chills, and cough; cough and sore throat; fever and headache; and fever, chills, sore throat, and headache. The viral load at diagnosis, estimated on the basis of the qPCR cycle threshold, was on average approximately 4 times as high in the 5 symptomatic participants as in the 46 participants who were asymptomatic (Table S2). However, some asymptomatic participants had high viral loads estimated on the basis of the cycle threshold (Fig. S1).

A total of 26 of the 1554 nonparticipants (1.7%) were found to be positive on day 14 as a result of qPCR testing at the end of quarantine,

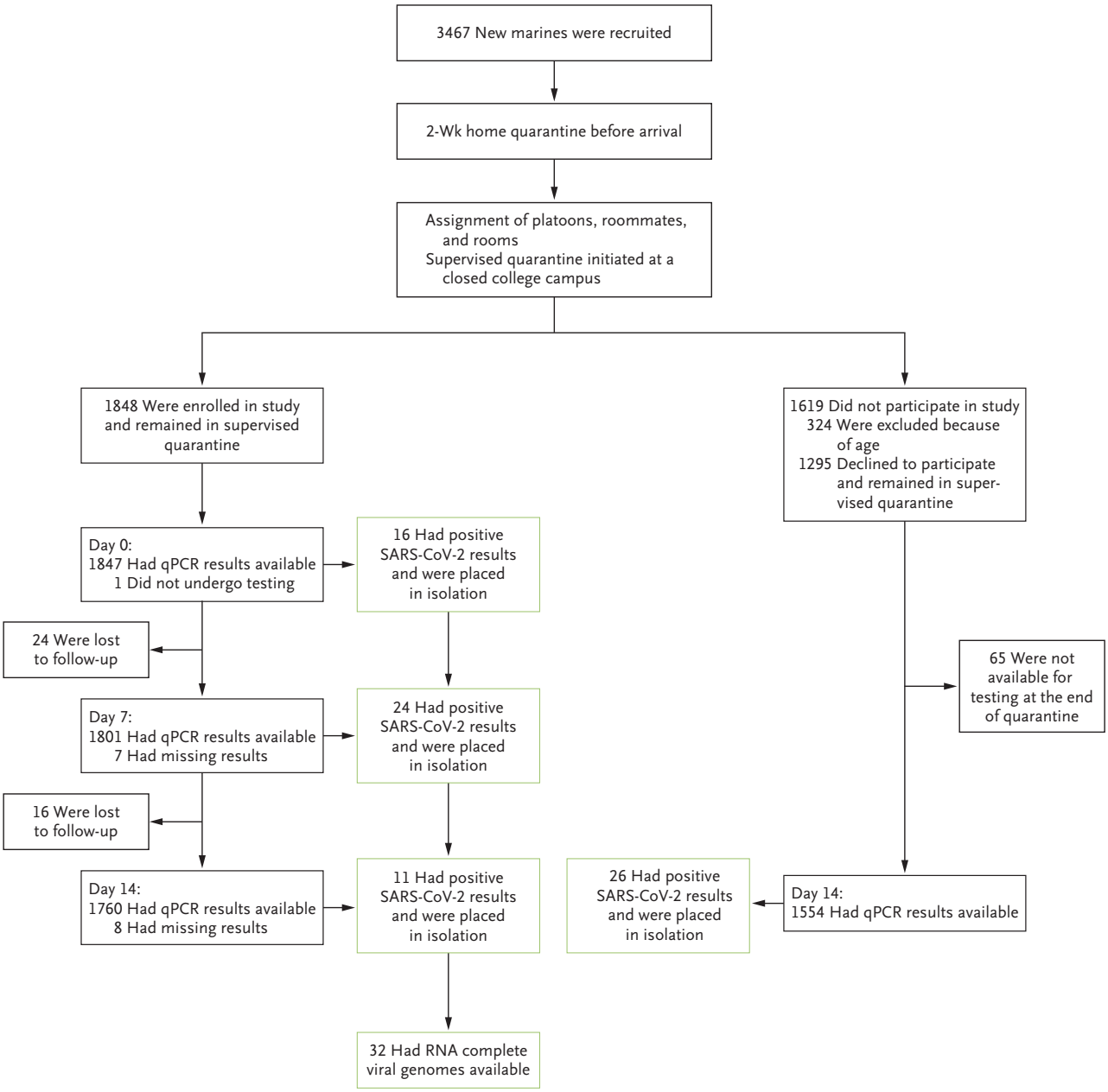

Figure 1. Study Design for SARS-CoV-2 Testing during Quarantine.

Marine Corps recruits entering a strict, supervised 2-week quarantine from May 15 to July 15, 2020, at a closed college campus were recruited for the COVID-19 Health Action Response for Marines (CHARM) longitudinal study for monitoring the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. Recruits who were not enrolled in the study were tested by means of quantitative polymerase-chain-reaction (qPCR) assay, as required by the Marine Corps, after 14 days of quarantine.

which was mandated by the Marine Corps. A total of 24 of 77 (31.2%) infected participants and nonparticipants had an infected roommate (Table 1). All study participants and nonparticipants underwent daily screening that included temperature checks and oral reporting of symptoms; follow-up qPCR testing was performed if indicated by the surveillance check. The results of the mandated symptom screening, which was independent of the study questionnaires regarding symptoms, was not known to the study investigators; however, no recruit with SARS-CoV-2 infec-

Table 1. SARS-CoV-2 Positivity, Presence of Symptoms, and Infected Roommates.*

Variable	Day 0	Day 7	Day 14
		number/total number (percent)	
Study participants			
First positive qPCR result†	16/1847 (0.9)	24/1801 (1.3)	11/1760 (0.6)
Cumulative no. of recruits with positive qPCR results‡	16/1847 (0.9)	40/1848 (2.2)	51/1848 (2.8)
Cumulative no. of symptomatic recruits§	1/16 (6.3)	4/40 (10.0)	5/51 (9.8)
Nonparticipants¶			
Positive qPCR result	Not tested	Not tested	26/1554 (1.7)
All recruits, including study participants and nonparticipants			
Cumulative no. of recruits with positive qPCR results	16/1847 (0.9)	40/1848 (2.2)	77/3402 (2.3)
Cumulative no. of recruits with a positive roommate‖	0/16 (0.0)	4/40 (10.0)	24/77 (31.2)

* The abbreviation qPCR denotes quantitative polymerase chain reaction, and SARS-CoV-2 severe acute respiratory syndrome coronavirus 2.
† The total number on day 0 does not include 1 participant who was enrolled on day 7. The total number on day 7 includes 1 participant who was first tested on day 7 and excludes participants whose test results were missing (7 participants), who were lost to follow-up (24 participants), or who were previously positive (16 participants). The total number on day 14 includes 1 participant who was first tested on day 7 and excludes participants whose test results were missing (8 participants), who were lost to follow up (40 participants [including 24 who did not return on day 7 or day 14 and an additional 16 participants who did not return on day 14]), or who were previously positive (40 participants).
‡ The cumulative total number includes all recruits who underwent testing up to and including the relevant test day.
§ Symptomatic recruits had a fever or any symptoms within the 7 days before the positive test result. The total number is the cumulative number of study participants with positive qPCR results.
¶ Information regarding the symptoms of nonparticipants is not available. Recruits who did not participate in the study underwent testing only on day 14, as mandated by the Marine Corps. A total of 1619 recruits were categorized as nonparticipants because of ineligibility or because they declined to participate in the study. The total number of 1554 recruits on day 14 includes previous study participants who dropped out of the study but remained at the quarantine site and does not include nonparticipants who were removed from the quarantine site or separated from the Marine Corps; the number of recruits in each of these categories is not known.
‖ The number of recruits indicates the number of positive recruits with a roommate who had a first positive test on or before the given test day, and the total number is the cumulative qPCR positivity for all recruits in this category.

tion was identified as a result of this clinically indicated testing. During the study period, one instructor was found to be positive in a test that was conducted as part of contact tracing related to an infected platoon member.

EPIDEMIOLOGIC ANALYSIS

To assess the epidemiologic features and transmission of SARS-CoV-2 in the context of this study, we obtained more than 95% complete viral genomes from 36 specimens obtained from 32 of 51 participants (62.7%) who had positive qPCR results for SARS-CoV-2; for 3 of these participants, genomes were recovered from samples obtained on more than one test day. Complete genomes could not be recovered from the other samples. Phylogenetic analyses that compared the recovered sequences with those recovered from patients in the United States and in other countries (a sample of 11,434 sequences) showed that most of the clades circulating in the United States were represented in SARS-CoV-2 isolates detected among recruits, a finding consistent with the geographic diversity of the participants (Fig. S2).

Six independent monophyletic transmission clusters defined by distinct mutations relative to the sampled data from U.S. and global data sets were identified — a result consistent with local transmission during the supervised quarantine. These strains were found in 18 participants; 1 participant had two different cluster strains isolated from samples obtained on different days. Two participants who had had positive qPCR results on day 0 were each infected with different cluster strains (Tables S3 and S4). Epidemiologic data showing infected roommate pairs and the relationship of cluster strains to platoon assignments supported the phylogenetic evidence for transmission of these strains at the supervised quarantine location. Among the participants infected with one of the six cluster strains of SARS-CoV-2, a total of 14 participants shared platoon assignments with other members who were in the same cluster. In addition, 10 infected recruits without sequenced SARS-CoV-2 isolates were as-

Table 2. Phylogenetic Analysis and Epidemiologically Inferred Transmission Clusters.

Phylogenetic Cluster	Sequenced Strains*	No. of Infected Recruits in the Same Platoon without Sequenced Isolate†	No. of Genomes in Cluster	No. of Infected Recruits with an Infected Roommate
	no. of strains (no. in same platoon)			
Cluster 1	2 (0)	3	5	0
Cluster 2	6 (6)	3	9	6
Cluster 3	2 (2)	0	2	2
Cluster 4	2 (2)	0	2	0
Cluster 5	5 (4)	4	9	4
Cluster 6	2 (NA)‡	0	2	0
Total	19 (14)	10	29	12

* A total of 19 genomes belonging to 6 cluster strains were obtained from 18 participants. One participant had 2 different virus strains identified in samples obtained at different times.

† Values indicate the number of infected study participants or nonparticipants who were assigned to the platoon most associated with the phylogenetically defined transmission cluster. The transmission cluster was defined according to the SARS-CoV-2 strain sequence. Infected recruits in each platoon with the highest proportion of participants infected with a sequenced cluster strain were tentatively assigned to that cluster if no sequenced isolate was obtained from that recruit.

‡ The platoon assignments of these participants were not available.

signed to the same platoons as the participants in transmission clusters defined by viral sequencing. There were three different clusters among six pairs of infected roommates (Table 2).

The infected participants with sequenced isolates belonging to phylogenetically identified cluster 2 or 5 had room assignments in the same hallway (Fig. 2). Cluster 2 was composed of recruits in platoon F. Cluster 5 was composed of recruits in platoon E, with the exception of a single recruit in platoon F, whose roommate was an infected recruit in platoon E. Aside from this one event, we did not find evidence for transmission events across these platoons, even though recruits in each platoon were staying in rooms in the same hallway and shared a bathroom.

DISCUSSION

We describe the results of a quarantine of nine Marine Corps recruit classes (a population of 3402 recruits) that participated in a public health mitigation program for Covid-19; recruits were under the constant supervision of Marine Corps instructors. Other settings in which young adults congregate are unlikely to reflect similar adherence to measures intended to reduce transmission. At the time of enrollment, after 2 weeks of home quarantine, approximately 1% of study participants had positive qPCR results, and approximately 2% subsequently became infected during the 2-week supervised quarantine period.

Study participants completed a detailed symptom questionnaire on each day of the scheduled qPCR testing. Approximately 10% of the infected study participants reported that they had had symptoms during the week before a positive qPCR result or on the day that testing occurred. Independent of the study, all participants and nonparticipants underwent a daily temperature check and brief symptom screening, as mandated by the Marine Corps; follow-up clinical qPCR testing was performed only if indicated by this screening. During the supervised quarantine period, no SARS-CoV-2 infections were identified as a result of clinical testing performed because of symptom screening. All cases of infection in recruits were diagnosed as a result of the scheduled qPCR testing performed on days 0, 7, and 14 (in study participants) and on day 14 (in nonparticipants).

Viral genomes were recovered from almost two thirds of infected study participants. Phylogenetic analysis of these genomes identified six independent monophyletic transmission clusters indicative of local transmission during the super-

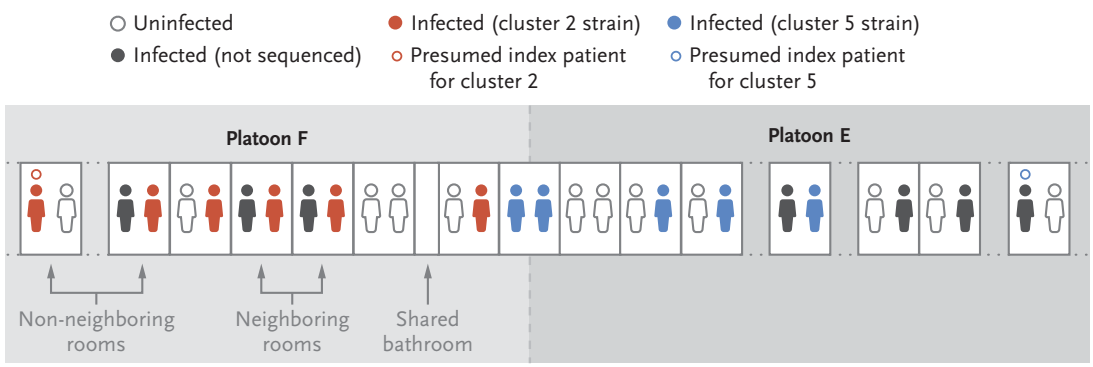

Figure 2. Local Transmission of SARS-CoV-2 during Quarantine.

Participants who were associated with the two largest transmission clusters (clusters 2 and 5) were identified by means of sequencing and were either roommates or members of the same platoons, which indicates that double-occupancy rooming and shared platoon membership were important contributors to transmission. Other infected members of these platoons whose samples were not sequenced may have been infected with the same cluster strains. One recruit in each platoon was found to be infected at the beginning of quarantine and represents the potential source of each cluster strain.

vised quarantine. Most clusters predominantly included members of the same platoon, and many infected recruits had an infected roommate. The two largest sequence-defined clusters occurred in the same class of recruits, and each cluster occurred within a platoon, with the exception of one recruit, who was roomed with an infected recruit from another platoon and was infected with a strain that belonged to the same cluster as that found in other members of that platoon. Although many infected recruits in both clusters had nearby room assignments and shared a bathroom, the epidemiologic analysis suggests that platoon membership and double-occupancy rooming were risk factors for infection, but room proximity and shared bathrooms were not (Fig. 2).

The index patient for each cluster strain could have been a study participant, a nonparticipant among the 26 found to be infected when tested at the end of quarantine, a nonparticipant who was infected at the time of arrival on campus but cleared the virus by the end of quarantine, or other personnel. During the study, only one instructor tested positive after rapid qPCR SARS-CoV-2 testing, indicating that instructors were an unlikely source of infection. Although campus service workers cannot be excluded as sources for virus introduction, they were separated from the recruits and instructors. Overall, the recruits are the most likely source of introduction and transmission of the cluster strains.

Two recruits who had positive qPCR results on day 0 may have been the index patients for the strains involved in the two largest clusters that spread among members of their platoons. A third recruit who may have been the index patient for a cluster had a positive qPCR result on day 0, and his roommate, infected with the same strain, received a diagnosis on day 14. None of the three potential index patients reported symptoms, which is consistent with asymptomatic transmission. We could not reconstruct the chain of infection for each cluster because complete viral genomes could not be recovered from all study participants, and samples from infected nonparticipants were unavailable for analysis. A limitation of this study is that the infection rate during the supervised quarantine period could not be estimated accurately because of possible false negative qPCR tests and because infection may have been acquired during the first self-quarantine at home or during travel to the campus but was not yet detectable on day 0 by means of qPCR assay.

Our study showed that in a group of predominantly young male military recruits, approximately 2% became positive for SARS-CoV-2, as determined by qPCR assay, during a 2-week, strictly enforced quarantine. Multiple, independent virus strain transmission clusters were identified. Shared rooms and shared platoon membership were risk factors for transmission. Most

study participants with positive qPCR tests were asymptomatic, and all cases among participants and nonparticipants were identified as the result of scheduled testing rather than clinical qPCR testing performed as a result of daily screening.

The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the U.S. Navy, the Department of Defense, the U.S. government, or the institutions affiliated with the authors.

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APPENDIX

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The Swedish COVID-19 approach: a scientific dialogue on mitigation policies

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During the COVID-19 pandemic, Sweden was among the few countries that did not enforce strict lockdown measures but instead relied more on voluntary and sustainable mitigation recommendations. While supported by the majority of Swedes, this approach faced rapid and continuous criticism. Unfortunately, the respectful debate centered around scientific evidence often gave way to mudslinging. However, the available data on excess all-cause mortality rates indicate that Sweden experienced fewer deaths per population unit during the pandemic (2020–2022) than most high-income countries and was comparable to neighboring Nordic countries through the pandemic. An open, objective scientific dialogue is essential for learning and preparing for future outbreaks.

KEYWORDS

COVID-19, SARS-CoV-2, lockdown, excess mortality, scientific dialogue, health policy, Sweden

Key points

- The voluntary, comparatively open policy of the Swedish approach to the COVID-19 pandemic appears to have caused less serious consequences than the lockdown policy used in most countries. However, there may also be other unknown explanations for our findings.
- Learning from the COVID-19 experience is important. Although future pandemics may manifest differently, maintaining an open scientific approach and fostering dialogue will be essential.

Introduction

During the COVID-19 pandemic, Sweden was among the few countries that did not enforce strict lockdown measures. Instead, the country relied on its citizens' voluntary behavioral changes, considering them to be more sustainable. This approach involved enforcing physical distancing, encouraging working from home, limiting social gatherings and travel, prohibiting most public events, and so on. Initially, masks were mandatory only in healthcare and older adult care settings, but later they were also recommended for crowded public transport. Kindergartens, primary schools, and secondary schools remained open throughout the pandemic, which was a unique policy. A large majority (>90%) of the

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Swedish population approved, endorsed, and complied with the Swedish policies, according to repeated public polls conducted during the pandemic by the Swedish Civil Contingencies Agency (1).

However, the Swedish approach was heavily criticized by a significant number of scientists at the national (2, 3) and international levels (4, 5) for being too permissive and complacent and, in particular, for keeping schools open and for not legally enforcing mask-wearing in public spaces. That being said, in 2022, opponents of the Swedish policy presented a review of selected publications, largely non-peer-reviewed newspapers, magazines, and reports, which painted a quite negative but scientifically questionable picture of the mitigation and outcome of the Swedish epidemic (6). In contrast, already early in the pandemic, other scientists proposed that the vulnerable groups should be strongly protected but otherwise avoid strict lockdowns (7, 8). The Swedish model has also received support from scientists and was recently considered quite reasonable (9). Unfortunately, the respectful debate regarding the pros and cons of various mitigation policies was often overshadowed by mudslinging and hatred, which even involved scientists (2, 4, 10).

Existing official statistics at both the European and global levels regarding total COVID-19-associated and excess overall mortality rates suggest that Sweden was less affected than most comparable countries that implemented stricter lockdown measures (11–13). Therefore, we summarize the mostly used and referred data on excess all-cause mortality in Sweden and other European countries over the past 3 years (2020–2022).

TABLE 1 Excess all-cause mortality (deaths per 100,000 inhabitants) in 14 European countries in relation to the degree of lockdown as estimated by the highest Stringency index (SI) during spring 2020 (Our World in Data).

	Excess all-cause mortality (deaths per 100,000 inhabitants)			SI%*
	2020	2021–2022	2020–2022	2020
Sweden	85	69	158	65
Norway	3	127	129	80
Denmark	2	94	97	72
Finland	26	204	228	85
Belgium	161	100	262	81
France	84	122	207	91
Germany	52	183	241	75
Italy	194	254	451	92
Netherlands	93	164	262	80
Poland	169	294	475	81
Portugal	120	221	273	82
Spain	162	169	332	85
Switzerland	110	106	221	77
United Kingdom	127	153	289	80

*Stringency index (%) estimated from a composite measure of 9 community response/restriction indicators such as school closures, workplace closures, travel bans, etc., rescaled to a value from 0 to 100% according to Our World in Data (12).

Methods

Secondary data were assembled from the websites of Worldometer (11), Our World in Data (12), the Swedish Public Health Agency (14), and the Swedish National Board of Welfare (15). We specifically opted for excess mortality as our measure of choice, considering that the reported COVID-19-associated deaths can vary depending on different definitions of COVID-19 deaths and may include many deaths where COVID-19 was not the cause of death, especially in 2021–2022. Moreover, by examining all-cause mortality, we included deaths that could potentially be indirectly attributed to the negative effects of strict lockdown measures and the overall strain on healthcare systems, leading to reduced access to healthcare for other diseases, among other factors.

Results

Excess all-cause mortality and estimated degrees of lockdown (intervention index) are presented for 14 selected European countries in Table 1 (12). Among 42 European countries, the cumulative excess all-cause mortality from January 2020 to December 2022 ranged from 46 (Luxembourg) to 1,080 (Bulgaria) deaths per 100,000 inhabitants, with a median of 351/100,000. In Sweden, the excess mortality rate of 158/100,000 was among the lowest, ranked 37th among 42 countries, and not very different from other Nordic countries: Norway (129), Denmark (97), and Finland (228). In most countries, the excess mortality was highest in 2020, before the COVID-19 vaccination was introduced. It was estimated to be 85/100,000 in Sweden, whereas, in Europe, the excess mortality ranged from −9 (Iceland) to 287 (North Macedonia), with a median of 111. The excess mortality in Sweden was thus higher than that in the three neighboring Nordic countries (2, 3, and 26/100,000), partly explained by a higher initial COVID-19 transmission (replication rate), comparable to other European countries (9) and possibly by mortality displacement due to low all-cause mortality in 2019 (16), and perhaps also by poorly organized older adult care structures and an initial lack of protective equipment in these settings (9, 17).

Interestingly, excess mortality during the second and third years of the pandemic (2021–2022) showed a different profile, with a comparatively low figure for Sweden (69/100,000) compared to the Nordic countries (97–204) and Europe in general (median 192) (12). Only Liechtenstein and Luxembourg had lower excess mortality. Reported COVID-19-associated deaths provide a similar overall picture for Europe although with some significant differences at the individual country level between the reported COVID-19 mortality and the estimated excess mortality (11, 12).

Like many other countries, Sweden largely failed to protect vulnerable older adults, especially before vaccines were rolled out (17). Hence, ∼40% of the COVID-19-associated deaths were among patients in nursing homes, and 67% of all COVID-19 deaths were among individuals above 80 years of age, representing 10% of all deaths in that age group. COVID-19 deaths below 50 years of age represented only 1.2% of all COVID deaths, including 21

individuals below 20 years of age, mostly with underlying co-morbidities, representing 1% of all deaths in that age group (15).

Discussion

Evaluating the outcome of the pandemic and the different mitigation policies is complex and difficult. Excess all-cause mortality during the pandemic, relative to expected mortality, is widely considered a reasonably objective and comparable indicator of both direct and indirect COVID-19-associated deaths (13). It is even more difficult to estimate the overall public health impact in relation to COVID-19 morbidity ("long/post-COVID-19"), mental health effects from lockdown measures, etc. Hence, any data should be interpreted with caution.

The impact of restrictions is not always evident. Intervention policies are thus difficult. Similar to governments in other countries, the Swedish government was aware that strict lockdown measures, such as closing businesses and schools, would have significant social and economic consequences although the main goal was to counteract the pandemic and save lives. In addition, according to Swedish law, politicians cannot govern over independent national authorities such as the Public Health Authority. Current evidence suggests that keeping schools open had limited consequences for the spread of the epidemic and the occurrence of COVID-19 disease, at least in Sweden (18, 19). Furthermore, experts from UNICEF (20) and UNESCO (21) in the present times concurred that school closures had more harmful effects than benefits. A Cochrane meta-analysis revealed that the use of face masks in public space "makes little or no difference" (22), in contrast to many scientists' views, such as those of the Royal Swedish Academy of Sciences (23). Harsh lockdown restrictions may also negatively affect economic and human development, health promotion, and disease prevention, which must be considered when public health consequences are summarized (24). Moreover, several country-specific factors, such as healthcare systems, may influence both COVID-19 transmission (25) and mortality. Hence, what is important and works well in one society may not be optimal in another. Thus, comparisons across countries are inherently difficult and require humility, openness, and objective scientific analysis as evidence becomes available.

In Sweden, excess mortality was especially low from 2021 to 2022, which could be partly due to the high initial mortality rate in 2020 among frail older adults in nursing homes, with a short remaining life expectancy. The fact that numerous countries also experienced significant excess mortality in 2021–2022 may suggest that strict lockdown may have caused negative indirect health effects. It is also possible that the voluntary measures implemented in Sweden were more sustainable and/or that the establishment of protective immunity from previous COVID-19 infection and/or vaccination was not as widespread.

This study also has some limitations. Countries may differ in how they report and quantify the factors that contribute to the lockdown stringency index. Additionally, mortality rates in the years before the pandemic may influence the estimation of excess death rates during the epidemic. Notably, our comparisons are limited to European countries, and the findings may be less relevant for non-European countries with very different structures and populations.

Even though our presented results suggest that strict lockdowns of society may not be the most effective approach and could potentially have counterproductive effects, it is important to exercise caution when drawing practical implications from our analyses. Conclusions regarding future approaches to epidemics should be based on more comprehensive studies that are tailored to different regions and various types of infectious agents.

In conclusion, Sweden experienced relatively fewer deaths per population unit than most other high-income countries that implemented stricter lockdown measures. It is concerning that some scientists who advocated for stringent measures seem to disregard real-world data and cling to their version of reality. The ability to learn from mistakes and acknowledge that hypotheses may be wrong is essential for future pandemic preparedness. This, coupled with careful analysis, is crucial for developing effective strategies in the face of future outbreaks.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

JL conceived the idea, contributed to data collection, and wrote the first draft of the manuscript. AB contributed to data collection. All authors critically reviewed the manuscript and approved its final version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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How did the Covid pandemic response harm society? A global evaluation and state of knowledge review (2020-21)

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Abstract

Early in the Covid pandemic concerns were raised that lockdown and other non-pharmaceutical interventions would cause significant multidimensional harm to society. This paper comprehensively evaluates the global state of knowledge on these adverse social impacts, with an emphasis on their type and magnitude during 2020 and 2021. A *harm framework* was developed spanning 10 categories: health, economy, income, food security, education, lifestyle, intimate relationships, community, environment and governance. The analysis synthesizes 600 publications with a focus on meta-analyses, systematic reviews, global reports and multi-country studies. This cumulative academic research shows that the collateral damage of the pandemic response was substantial, wide-ranging and will leave behind a legacy of harm for hundreds of millions of people in the years ahead. Many original predictions are broadly supported by the research data including: a rise in non-Covid excess mortality, mental health deterioration, child abuse and domestic violence, widening global inequality, food insecurity, lost educational opportunities, unhealthy lifestyle behaviours, social polarization, soaring debt, democratic backsliding and declining human rights. Young people, individuals and countries with lower socioeconomic status, women and those with pre-existing vulnerabilities were hit hardest. Societal harms should challenge the dominant mental model of the pandemic response: it is likely that many Covid policies caused more harm than benefit, although further research is needed to address knowledge gaps and explore policy trade-offs, especially at a country-level. Planning and response for future global health emergencies must integrate a wider range of expertise to account for and mitigate societal harms associated with government intervention.

Introduction

The Covid pandemic was the most disruptive global crisis since the Second World War. Impacts across countries and social groups went far-beyond the mortality and morbidity burden of the virus itself. The use of unprecedented government restrictions transformed a health emergency into a worldwide societal crisis, the impacts of which will be felt for decades. In an effort to control Covid, governments implemented a range of legal mandates and policies to restrict human movement and social behaviour starting in March/April 2020; national lockdowns were imposed in roughly 150 countries (Hale et al. 2021). Governments then maintained and/or reimposed different containment and closure policies, economic responses and health system responses throughout much of 2020 and 2021 (see Table 1). Some of these policies remained in place as late as 2022-23.

Table 1: The range of Covid policies implemented worldwide*

Containment and closures	School closing, workplace closing, cancel public events, restrictions on gathering size, close public transport, stay-at-home requirements, restrictions on internal movement, restrictions on international travel
Economic responses	Income support, debt/contact relief for households, fiscal measures, giving international support
Health systems	Public information campaign, testing policy, contact tracing, emergency investment in health care, facial coverings, vaccination policy.

* *According to the Oxford Covid government response tracker (Hale et al. 2021).*

The use of these non-pharmaceutical interventions (NPIs), including lockdown, represented the most consequential set of policies in modern public health history. Whole societies and economies were shut down, billions of people were confined to their homes, social interactions were deemed unsafe and outlawed, markets and transport were stopped and democratic processes were suspended under emergency law. From the beginning, there were major concerns that lockdown and other NPIs would cause widespread social harm, especially among vulnerable and poorer communities (Bavli et al. 2020; Broadbent et al. 2020). Other early work sought to cast doubt on these concerns using selective data points (Meyerowitz-Katz et al. 2021).

A vigorous and consequential public and scientific debate has continued about these disease control policies. Using the cumulative research data generated so far, this paper aims to answer the question: *how did Covid pandemic policies harm society?* In approaching this question, four issues are worth noting.

First, there is a general tendency for the public health community to be overly optimistic about the benefits of their interventions and under-play or ignore their harm. This has been acknowledged as a neglected area of research in the academic literature (Allen-Scott et al. 2014; Bonell et al. 2015); Lorenc and Oliver (2014) put it this way: *"Public health contrasts markedly with clinical medicine, where there is a substantial literature on adverse events and patient safety, and the Hippocratic injunction to 'do no harm' is arguably more salient."* There are a number of pertinent social science concepts and analytical traditions that can help guide an analysis of the harms of the pandemic response (Table 2).[1] Some of these have already been been used in various publications: unintended consequences (Turcotte-Tremblay et al. 2021), social harm (Briggs et al. 2021), collateral damage (Green and Fazi, 2023) and cost benefit analysis (Allen, 2022; Cornwall 2020; Miles et al. 2021; Lally 2022; Yakusheva et al. 2022; Fink et al. 2022). This paper integrates these concepts and aims to advance this neglectd area of public health research.

Second, concerns about harms are grounded in the long-standing consensus that 'health' is much more than disease control; the World Health Organization defines health as *"a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."* Decades of mainstream public health research have shown that human health is influenced by the *social determinants of health*, operating in multifaceted ways over a lifespan. The US Department of Health and Human Services defines this as: *"the conditions where people are born, live, learn, work, play, workship and age that affect a wide range of health, functioning and quality-of-life outcomes and risks."*[2] This

[1] An additional metaphor comes from medicine itself: one of the main biological pathways that leads to Covid mortality is the cytokine storm, generated by an excessive immune response rather than the virus
[2] See: https://health.gov/healthypeople/priority-areas/social-determinants-health

means that any meaningful evaluation of the Covid pandemic response should use a broader conceptual framework to consider impacts beyond Covid disease.

Table 2: Useful social science concepts

Concept	Description
Unintended consequences	Considered a "law" of purposive social action, according to sociologists. Some consequences should be anticipated. Generally supports the idea that policy decisions often involve 'trade-offs' or the 'lesser of two evils.' Political decision-making with high-levels of adverse unintended consequences often involve: error, ignorance, intentionality, value-based decisions and groupthink. See: Turcotte-Tremblay et al. (2021); De Zwart (2015).
Social harms	From the field of criminology. "Crime" is conceptualized as a social construct. Shows that anti-social behaviors that are legal are also harmful and that social structures and the lack of safety nets cause harm to individuals, families and communities. Critiques crime control and the criminal justice system as ineffective. See: Briggs et al. (2021); Canning and Tombs (2021); Hillyard et al. (2004)
Collateral damage	From political science, having gained popularity after the Vietnam war. Warzone statistics about civilian casualties is highly political and challenging to determine. Critics argue that the term itself is an "inhumane euphemism" that aims to make civilian casualties palatable to the public. It is not clear what level of noncombatant casualty is acceptable. Precision-guided weapons are believed to have reduced civilian casualties. See: Rosén (2016); Condra and Shapiro (2012)
Iatrogenic harm	From the social critique of medicine meaning, "harm caused by medical care." This involves diagnosis, intervention, negligence and error. Related to the concept of over-medicalization, which occurs at clinical, social and cultural levels. See: Illich (1976); Panagioti et al. (2019); Hodkinson et al. (2020); Makary and Daniel (2016).
Compound risk	From disaster studies: the idea that multiple hazards occur at the same time and that vulnerability builds on itself. Also related to other ideas in disaster management such as the broken window fallacy, second disaster and anti-politics. See: Kruczkiewicz et al. (2021)
Cost benefit analysis	From economics: focused on assessing if benefits are likely to overweigh costs and risks of a set of actions and policies. Cost-benefit analysis is influenced by data, quantification techniques and model projections. Relies on both monetized metrics (QALY, GDP) and non-monetized metrics (well-being-adjusted life-year; subjective well-being measures). See: Aldred, 2022; Allen (2022); Cornwall (2020); Fink et al. (2022); Heinzerling, (2000); Miles et al. (2021); Lally (2022); Yakusheva et al. (2022).

Third, the evidence-base for the effectiveness of many Covid interventions remains contested, with considerable disagreement and scientific debate. It is important to appreciate that, prior to Covid, many in the public health community supported a cautious skepticism about the types of government restrictions and mandates widely used in 2020-21. Fear-based messaging, punitive rules and lengthy restrictions on normal human interaction were seen as counter-productive, lacking strong evidence and, in many cases, unethical or unconstitutional (Jamrozik, 2022). There was reluctance expressed in pandemic influenza plans and during the West African Ebola outbreak to implement large-scale quarantines, school and business closures and movement restrictions that

would disrupt social life (Abramowitz et al. 2015; Eba, 2014; Inglesby et al. 2006; WHO, 2019). These concerns were both epidemiological and social. Now that the acute phase of the Covid crisis has passed, scientific evaluations are re-visiting assumptions about the justification for NPIs that were presented to the public as self-evident in 2020-21. This paper contributes to this important debate.

Finally, evaluations of Covid policy are dependent on the *politics of knowledge*, including the range, visibility, and quality of research data. In our current 'data-driven' technological society what is not measured, or easily measured and grasped, can more readily be ignored. There is a degree of imbalance in trying to mentally weigh the control of one virus (e.g. Covid) against the wide-range of social consequences from control policies: Covid statistics are much simplier to understand and communicate to the public. This cognitive process is partially the reason why public health responses frequently make use of war metaphors. In contrast, a multitude of different types of societal harms may appear diffused, hypothetical and difficult to measure. In this regard, methodological and epistemological limitations have restricted the public debate. Certain types of knowledge have also been more valued, and provided more weight, compared to other data.[3] This paper aims to address this imbalance. It aims to make more fully visible and transparent the wide-ranging interdisciplinary research on these social impacts. It also reflects on the state of global academic research, knowledge debates and data gaps.

Now that the crisis has passed, we can evaluate the collateral damage with a substantial amount of research data. In summary, this paper aims to: (1) further theoretical engagement with harm from public health interventions; (2) integrate a broad social determinants of health framework to evaluate the global Covid response; (3) further the scientific debate about the appropriatedness of non-pharmaceutical interventions; and (4) raise the visibility of interdisciplinary empirical research on societal impacts.

[3] There are many reasons for this. One appears to have been a form of motivated reasoning (which I call *covidization)* that over-emphasized the benefits and necessity of Covid interventions and downplayed their risks and societal costs. Covidization has meant that people were much more willing to accept greater multidimensional societal harm for hypothetical benefits against the virus. This report does not attempt an analysis of this complex phenomenon.

Methodology

Research questions

This paper aims to comprehensively answer two important questions:

1) *What types of adverse societal impacts occurred worldwide due to the Covid pandemic response in 2020-2021?*
2) *What does current research studies tell us about the magnitude of these impacts?*

To accomplish this, a conceptual framework was developed to guide the literature review and analysis. The literature review aimed to find the highest quality evidence across a large range of topics and scientific fields. A 'societal harm' framework of the findings from the state of knowledge review was created based on 10 main categories. The paper is focused on the impacts of non-pharmaceutical interventions; the author has previously written about the role of social science in pandemic response (Bardosh et al. 2020) and on the unintended consequences of Covid vaccine policy (Bardosh et al. 2022).

Conceptual framework

The conceptual framework (Figure 1) accounts for different drivers of societal change, contextual factors, social effects, scales of impact and different forms of evidence. These are briefly outlined here.

Drivers of change: Four main drivers that are hard to isolate from one another influenced the societal response to the Covid pandemic. This includes the various non-pharmaceutical interventions (and vaccination programs that began in 2021) as well as viral infection itself and voluntary behaviour changes in the face of a novel virus. This is further complicated by psychological and social feedbackloops since risk perceptions were shaped by government policies; e.g. lockdowns, other NPIs and media framings created and reinforced high levels of fear, anxiety and concern. Although this paper does engage with these issues to some degree, by citing studies that distinguish between these different drivers of change, further work is needed in this area. Efforts were also made to account for resilience and relief efforts that aimed to mitigate harms.

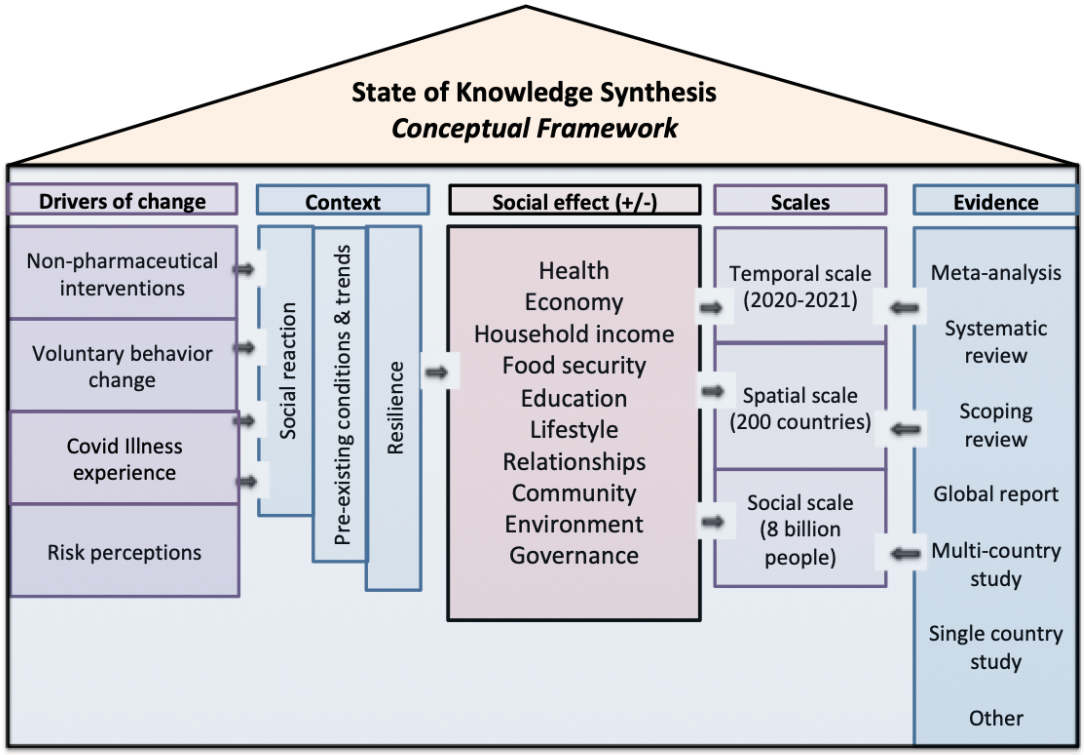

Figure 1: Conceptual Framework

Context: A second methodological issue was the need to account for contextual factors in making claims about societal effects. Social reactions are influenced by a large variety of human experiences, perceptions and structural conditions. Some social groups and countries are more resilient to crises than others. Pre-existing conditions and trends are difficult to account for; e.g. estimates of excess mortality must take into account variations in age demographics and are influenced by the timeframe used to determine 'normal' mortality rates, etc. Another example of this relates to increases in global food insecurity, which was increasing prior to the pandemic.

Social effects: The main aim of the analysis was to identify the types of adverse societal consequences from the pandemic response and to explore relevant research data on their magnitude. This required intellectual flexibility and an inductive approach to build interpretative understanding. The framework presented below went through various iterations, with a final 10 categories and over 50 sub-categories of harm (see **Figure 2**).

Of course, not all social effects were negative for all people (e.g. the initial lockdown period was experienced as an opportunity to spend more time with family by a proportion of people; natural ecosystems showed some recovery, etc). Some of these positive impacts are mentioned in the paper. The goal of the analysis was not to conduct a systematic cost-benefit analysis or to weigh different positives and negatives. Rather it was to review the research data on adverse consequences.

Scales: The paper synthesizes data at different scales. Temporally, public reactions and government policies changed considerably over time in 2020 and 2021. Countries also pursued very different response strategies. Substantial variation occurred in the different psychological, socio-economic and cultural responses and experiences of 8 billion people. Nonetheless, generalizations are possible; athough the analysis approached this with caution.

Evidence: A large range of reseach evidence was used during the analysis: meta-analyses, systematic and scoping reviews, reports from recognized international bodies such as the UN system and civil society watchdogs, multi-country studies, single country studies and various commentaries and conceptual analyses. These are described in more detail below.

Literature review strategy

The literature review was conducted in three phases between September 2022 and March 2023. In total, 604 documents are included in the body of the analysis (Table 3).

Table 3: Literature included in the state of knowledge review

Systematic reviews	Meta-analyses*	Reviews	Reports**	Multi-country studies	Single country studies	Other***
107	45	83	86	116	183	29

* All meta-analyses were also systematic reviews and hence are included in both categories.
** All papers were published in peer-reviewed journals except for the reports and 5 pre-print papers.
*** This included papers that reflected on methods as well as commentaries and conceptual analysis.

First, an initial conceptual framework guided the literature review strategy from previous work by *Collateral Global* (https://collateralglobal.org), which was divided by: education, mental health, economy, physical health, ethics, culture, inequality, and social health. For each of these categories, a rapid literature review was conducted using Google Scholar and PubMed. The goal was to find meta-analyses, systematic reviews, scoping reviews and expert commentaries on each topic. For each paper of interest, the abstract (and, in many cases, the full research paper) and reference list were scanned and a citation-based search using Google Scholar was used to identify additional studies of interest. From this original search, roughly 100 categories of harm were first identified.

A second literature search was then conducted on each of these 100 harms using Google Scholar. The first 10 pages were searched with the terms: [harm] and review, and [harm] and meta-analysis. Publications of interest were read in full and citation-based searches were used to identify further articles of interest. A separate search using Google was used to identify model predictions and studies from recognized international organizations such as the UN system and civil society groups.

The goal was to build a conceptual understanding of the debate in each field and to present generalizable trends and findings. This included reading broadly across a large range of scientific disciplines in order to assess if there was a concensus about the consequences of the pandemic and sufficient data to make claims about magnitude, social difference and causation. Hence, the literature review required diving into a large number of additional papers that are not included in the final analysis. Due to the large amount of research publications available, priority was given to studies that were published in 2022 and 2023 over those in 2020 and 2021. Studies that were prioritized included: meta-analyses; longitudinal cohort studies with pre- and during- pandemic data; and evaluations of earlier model predictions about harms. Many fields did not have meta-analyses or systematic reviews. Some reviews and studies were of poor quality. For this reason, the analysis includes a substantial number of multi- and single-country studies that were deemed to be high quality. Effort was made to select studies that included a

range of countries with different socio-economic status. As the analysis shows, there remain significant gaps in the available academic literature.

The literature review strategy was then validated in March 2023, by conducting a systematic literature search using Web of Science. The original attempt to search for 'review' and 'Covid' generated 37,275 results in Web of Science and 36,975 results in PubMed. Screening this level of data was not possible. Instead, Web of Science was searched for 'meta-analysis' or 'systematic review' and 'Covid' in the title. This yieled 5,831 results in Web of Science. Titles and abstracts were then screened. Protocols, commentaries, posters, bibliometric studies, intervention evaluations and all reviews having to do with the management of Covid clinical disease were excluded. A total of 315 papers were reviewed for analysis. The overwhelming majority of these were either already included in the analysis, were too specialized (e.g. a systematic review of online anatomy teaching during the Covid pandemic) or were of marginal overall value. Only 9 were deemed to be of interest and were included in the final paper. Most of the higher quality systematic reviews and meta-analyses of relevance had already been retrieved through the literature search strategy described above.

An analysis of this type is subject to multiple limitations, which are outlined in the discussion section of this paper.

Results: Societal harm framework

This paper summarizes the current global state of knowledge on the negative social consequences of the Covid response (2020-2021). Societal harms are analyzed across 10 categories and over 50 sub-categories, based on 600 research papers and evidence syntheses. Categories include: health, economy, income, education, food security, lifestyle, intimate relationships, community, environment and governance (Figure 2).

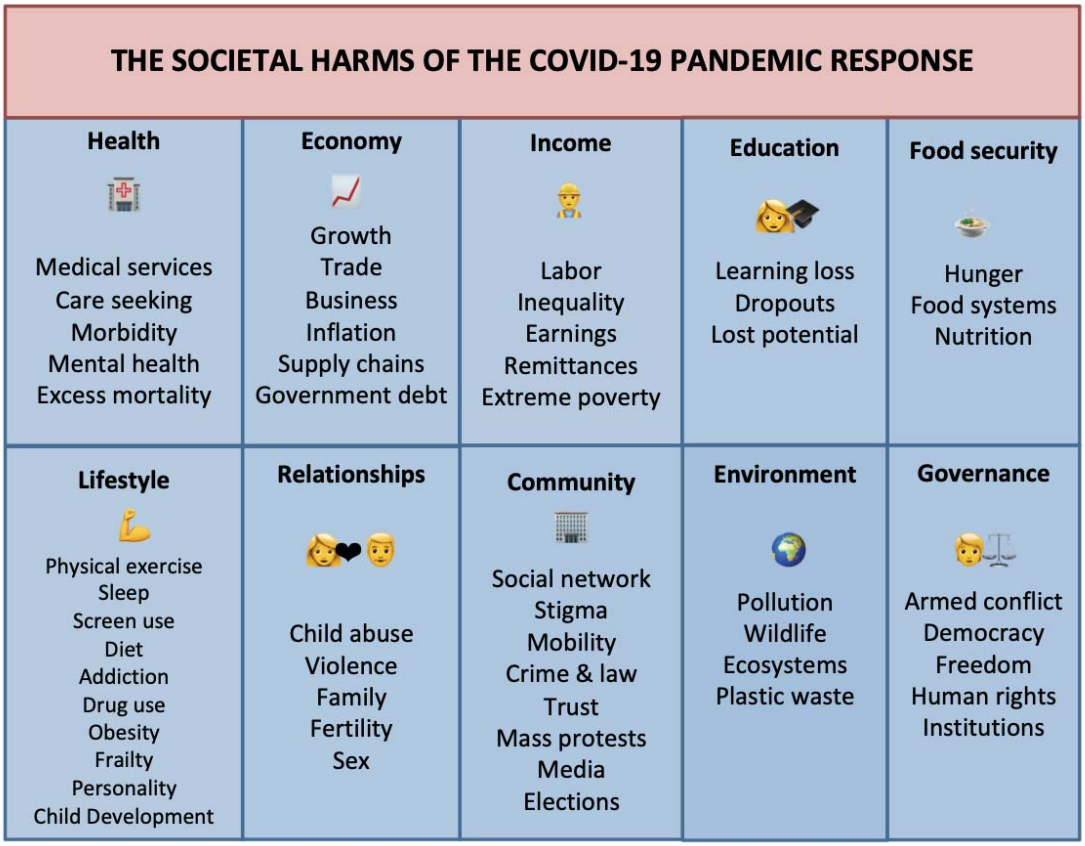

Figure 2: Societal harm framework

1. Health and medical services

1.1. Excess mortality

The World Health Organization (WHO) and others have estimated an increase in all-cause mortality of 14-18 million in 2020-21 (Msemburi et al. 2022; Shang et al. 2022; Wang et al. 2022), highest in middle-income countries (Alon et al. 2022). Reported Covid deaths account for 5-6 million. Numerous methodological challenges exist with current models and data (Beaney et al. 2020; Ioannidis, 2021; Kepp et al. 2022; Moeti et al. 2023; Nepomuceno et al. 2022). While many research papers suggest a large under-reporting of Covid mortality, others suggest lower total excess mortality rates (Levitt et al. 2022) and some over-counting of Covid mortality (Friss et al. 2023; White et al. 2022). The proportion of increased mortality from non-Covid deaths remains unclear, with little data currently available outside high-income countries.

Table 4: Changes in non-Covid excess deaths, identified by Sanmarchi et al. (2022)

1. Cardiovascular diseases
2. Cancer
3. Diabetes
4. Suicide
5. Cerebrovascular diseases
6. Road accidents
7. Chronic lower respiratory diseases
8. Diseases of the respiratory system (excluding Covid)
9. Infectious diseases (excluding Covid)
10. Ischemic heart disease
11. Unintentional injuries
12. Influenza and pneumonia
13. Alzheimer's disease
14. Hypertensive diseases
15. Kidney disease
16. Digestive system disease
17. Dementia
18. Mental and behavioural disorders
19. Diseases of the nervous system and sense organs
20. Diseases of the genitourinary system

Two meta-analyses and one systematic review were found on this topic. Lu et al. (2022) found an 18% general increase in excess mortality from non-Covid causes in 2020 while Lau et al. (2022) found a 5% increase in mortality for non-COVID illness compared with pre-pandemic data. However, the limited number of studies meant these conclusions had low certainty. A systematic review (116 studies) found statistically significant changes across 20 disease conditions (Table 4) (Sanmarchi et al. 2022).

Recent high-quality studies from North America suggest 20% of excess mortality was from non-Covid causes in 2020-21: 27% in Mexico (Palacio-Mejia et al. 2022), 17% in USA (Chan et al. 2021; Mulligan and Arnott 2022; Stokes et al. 2021)[4] and 18% in Canada (McGrail, 2022).[5] This rose to 70% for those less than 45 years old in the United

[4] An earlier study by Woolf et al. (2021) found that 28% of excess mortality in the first year of the pandemic in the USA was not accounted for in official Covid statistics, and likely related to undocumented Covid infection, delayed medical care and other factors.
[5] Half (5) of Canada's 10 provinces had more non-Covid excess deaths than Covid deaths, 2020-21.

States (Beesoon et al. 2022; Lee et al. 2023; Zalla et al. 2021), and was also higher among non-White ethnic groups (Cronin and Evans 2021; Habibdoust et al. 2022; Luck et al. 2022; Todd and Scheeres, 2022). Mortality increases were mainly found from hypertension and heart disease, diabetes, drug-overdoses, homicide, Alzheimer's, and motor vehicle fatalities.

Other studies, conducted early in the pandemic, have found higher proportions in: Greece (62%), Portugal (51%), Italy (40%), Poland (38%), and England (26%) (Kontopantelis et al. 2021; Kondilis et al. 2021; Odone et al. 2021; Pikala et al. 2022; Vieira et al. 2020). A 25% increase in hospital-based mortality from non-Covid causes in 2020 was reported in Dang et al. (2022) and Gasch-Illescas et al. (2023). Research from middle-income countries, e.g. Brazil (Guimaraes et al. 2022) and Peru (Cajachagua-Torres et al. 2022), also show substantial increases in non-Covid mortality but do not provide an overall proportionate estimate.

Three issues are worth noting: suicide, influenza and child deaths. Despite predictions that the economic recession would increase suicide (Glozier et al. 2022) evidence does not support an overall short-term increase in most countries in 2020-21, although small increases did occur in specific demographic groups (younger ages) and some countries (Borges et al. 2022; Pirkis et al. 2022; Webb et al. 2022 Knipe et al. 2022). However, disaster research suggests suicide increases may be delayed by a few years (Horney et al. 2020).[6] Secondly, the epidemiology of endemic pathogens, including influenza and other seasonal respiratory viruses, were disrupted during the pandemic contributing to less mortality in 2020-21. A subsequent resurgence of influenza and RSV occurred in 2022 due to immunity displacement (Cohen et al. 2021; Cohen et al. 2022).[7] Finally, mortality data is unavailable to evaluate model estimates regarding increases in general child mortality in low- and middle-income countries (LMICs), which ranged from 100,000 to 500,000 (Cardona et al. 2022; Shapira et al. 2021; Osendarp et al. 2021). Using health

[6] Some of the increases in drug-related mortality may also be interpreted as suicide-related (Rahimi-Ardabili et al. 2022).
[7] Interestingly, recent studies suggest that endemic coronavirus cross-immunity, which is thought to have reduced during the pandemic, may help protect against severe Covid outcomes (Filmore et al. 2022).

utilization data from 18 LMICs (all with low overall Covid mortality), Ahmed et al. (2022) estimated that 113,962 of 597,422 total excess deaths (19%) were due to excess under 5-child mortality. By comparison, and according to data from UNICEF, 4,480 children under 5 died with a reported Covid diagnosis during this time.[8]

Excess non-Covid mortality is predicted to remain elevated in the years ahead for many conditions, including anticipated increases in cardiovascular disease (Banerjee et al. 2021) and cancer (Lawler et al. 2022).[9]

1.2. Health services and outcomes

Reviews by WHO identified numerous adverse effects on non-Covid healthcare services (WHO, 2021; WHO, 2022). Two meta-analyses on health utilization were available. Molyniham et al. (2021) found a 37% reduction in health service utilization across all categories up until May 2020 across: visits (42%), diagnostics (31%), therapeutics (30%) and admissions (28%). A second review found a 56% decrease in outpatient care[10] across: diagnostics (63%), primary care (60%), specialty care, (58%), in-person visits (56%), emergency care (49%), and treatment (36%) (Dupraz et al. 2022). In addition, two large-scale studies, based on National Health Service data in low- and middle-income countries (LMICs), found 13% to 40% declines in outpatient volume in 2020 (Arsenault et al. 2022; Ahmed et al. 2022). Pulse survey data suggest disruptions persisted in early 2021, with 48% and 22% of countries reporting disruptions to primary care and emergency services (WHO and IBRD, 2021). Systematic reviews found large disruptions in cancer care (Ferrara et al. 2022; Teglia et al. 2022; Li et al. 2023; Van Vliet et al. 2023), cardiovascular services (Nadarajah et al. 2022), infectious disease programs (HIV, tuberculosis, malaria) (Baral et al. 2022), neurological services (Garcia-Azorin et al.

[8] See: https://data.unicef.org/resources/covid-19-confirmed-cases-and-deaths-dashboard/

[9] For example, excess mortality was 19% higher across Europe in December 2022 (77,000 additional deaths) compared to pre-pandemic trends (Eurostat, 2023a).

[10] This estimate is for in-patient services and does not account for the proportional increase in tele-services, which increased during the pandemic. It is unclear how widely tele-services were available and how much they mitigated the reduction in in-person care. Tele-services were limited in low- and middle-income countries (Eslami Jahromi and Ayatollahi, 2023).

2022), immunizations (Cardoso Pinto et al. 2022) and maternal health (Chmielewska et al. 2021).

Service disruptions increased non-Covid morbidity and mortality. For example, a large-scale cohort study (61 countries, 15 cancer types) found 15% of patients in regions with full lockdowns did not receive elective cancer surgery, in comparison to 5.5% in moderate lockdowns and 0.6% in regions with light restrictions (Collaborative, 2021). A review of non-Covid cardiovascular disease (158 studies) noted that *"there was substantial global collateral cardiovascular disease damage"* (especially in LMICs) and that clinical effects were similar in magnitude between wave 1 and 2 in 2020 (Nadarajah et al. 2022). No review was found on diabetes services, although individual studies in UK and Mexico show significant negative effects (Bello-Chavolla et al. 2022; Valabhji et al. 2022). A review of emergency services (98 studies) showed delayed presentation and treatment for heart attack, brain aneurysm, diabetes, and appendicitis (Mogharab et al. 2022). A review (30 studies) by Chmielewska et al. (2021) found increases in stillbirths, maternal deaths, ruptured ectopic pregnancies and maternal depression. How these service disruptions impacted both short and medium-term mortality and morbidity are unclear. In Europe alone, Lawler et al. (2022) estimated that up to one million new cancers went undiagnosed in 2020-21.

1.3. Mental health

Systematic reviews and meta-analyses confirm negative impacts on mental health but show large differences between point surveys and longitudinal cohort data (Husky et al. 2021; Kessler et al. 2022), with only limited clinical data available. Early reviews by Santabárbara et al. (2021) and Bueno-Notivol et al. (2021), based on self-reported rates of anxiety and depression, estimated 300% and 700% increases during lockdown compared to pre-pandemic rates. Leung et al. (2022) argued that the mental health toll of the pandemic was likely equivalent to major natural disasters and armed conflict. Meta-analyses have found varied self-reported population prevalences during the first half of 2020: 13-50% psychological distress, 16-28% depression, 15-33% anxiety, 24-30% insomnia, and 17-25% post-traumatic stress disorder symptoms (Cenat et al. 2021;

Nochaiwong et al. 2021; Leung et al. 2022). A review of systematic reviews found a 32% prevalence of depression and anxiety among children and adolescents (Harrison et al. 2022). A second meta-analysis by Panda et al. (2021) found 79% of children had adverse behavioral and psychological impacts and 52% and 21% of parents/caregivers developed anxiety and depression, respectfully.

However, meta-analyses of studies with longitudinal cohorts, comparing pre- and during-effects (mostly from high-income countries), show a overall small population effect size (SMD, -0.20, rising to –0.39 during the first 2 months of the pandemic), with considerable heterogeneity, suggesting that lockdowns did not have uniformly detrimental effects on mental health across society (Prati and Mancini, 2021; Robinson et al. 2022; Salanti et al. 2022). Longitudinal studies suggest mental health deterioration was high among children and adolescents (Kauhanen er al. 2022), although existing studies have a high degree of heterogenity and variation in study design (Newlove-Delgado et al. 2023). Based on longitudinal cohort studies, Santomauro et al. (2021) estimated an additional 53 million cases of major depressive disorder globally (a 28% increase) and 76 million cases of anxiety disorders globally (a 26% increase) in 2020. A review of data from the United States estimated a larger increase, with 30% to 50% increases in anxiety and depression during 2020, but lower than the 500% to 800% increase estimated in US nonprobability surveys (Kessler et al. 2022).

Pandemic restrictions disproportinately worsened mental health for certain individuals. Psychological studies, from Argentina and Canada, using latent-class analysis identified distinct classes of people, roughly 15% of individuals, more prone to mental health deterioration (Fernandez et al. 2022; Frounfelker et al. 2022). The pandemic created barriers to help-seeking for mental health problems (Yonemoto and Kawashima, 2022). Efforts have also been made to measure excessive fear or phobia of Covid itself (Muller et al. 2021), as well as the reasons for the over-estimation of personal risk (Graso, 2022). Reviews have shown that those with pre-existing psychiatric disorders (Carvalho et al. 2022; Theberath et al. 2022; Milea-Milea et al. 2023), mothers of young children (Racine et al. 2022), marginalized groups (socioeconomic disadvanteged, migrants, ethno-racial

minorities, homeless people) (Camara et al. 2022) and younger adults (Santomaur et al. 2021), also suffered greater adverse mental health effects.

A third source of evaluation are from clinical data. A systematic review of research from 18 countries found an increase in pediatric emergency department visits for attempted suicide and self-harm (Madigan et al. 2023). Two reviews by Meier et al. (2022) and Devoe et al. (2022) both reported an increase in eating disorders, including a 48% increase in US hospital admissions, highest among women and children and adolescents. An Italian study found an increase in somatic psychiatric disorders among children (4-14 years) during the pandemic period (Turco et al. 2022).

Few studies explore changes in mental health deterioration over time (Wade et al. 2023). A review of longitudinal studies found that depression, anxiety and loneliness peaked in May 2020 (and was highest in North America), although other mental health problems (such as PTSD and psychological distress) were higher after July 2020 (Cénat et al. 2022). Salanti et al. (2022) also found a peak for depression and anxiety during the first two months of the pandemic in 2020. A review of 11 longitudinal cohort studies in the UK found a sustained worsening in psychological distress throughout 2020 (Patel et al. 2022). A meta-analysis of data (2020-22) from children and adolescents found increases in depression and anxiety over time (Deng et al. 2022). Data is now emerging about longer-term effects, and individual studies (e.g. from Argentina, South Africa, Norway and Ghana) suggest mental health deterioration may not have improved in 2021 (Hoffart et al. 2022; Fernández et al. 2022; Durizzo et al. 2022).

2. Economy

2.1. Economic growth

According to the World Bank (2022), *"Mobility restrictions, lockdowns, and other public health measures necessary to contain the pandemic rapidly produced the largest global*

economic crisis in more than a century."[11] Economic contraction affected 90% of countries in 2020, with GDP per capita declining by 3.1%: 6.7% in emerging markets, 4.6% in advanced economies and 3.6% in low-income countries (Alon et al. 2022). A sharp U-shaped global recession occurred, with real GDP growth outpacing pre-pandemic growth in 2021 at 5.9% (vs 3.4% average growth, 2013-2019) (OECD, 2022). The rebound in growth was fast but uneven. Macroeconomic impacts are believed to have been most severe in middle-income countries due to higher NPI stringency, low levels of government relief and high job dependence on social interaction (Alon et al. 2022; Gagnon et al. 2023).[12] However, despite the U-shaped recovery in 2021, global economic growth has since stalled; the IMF (2022) predicts that *"the global economy is headed for stormy waters"* in 2023 and the World Bank (2023) warned that *"the crisis facing development is intensifying."* Growth forecasts for 2023 from the World Bank (2023) have been downgraded, from 3% GDP growth to 1.7%. By the end of 2024, GDP levels in emerging-market and developing economies are predicted to remain 6% below levels expected pre-pandemic. The precise contribution of the pandemic to future economic growth trends are unclear. However, international financial institutions worry that the 2020s may see a replay of the "lost decade" of development that occurred across Latin America and Sub-Saharan Africa in the 1980s (World Bank, 2022). The *Human Development Index* (HDI) declined globally in 2020 and again in 2021 (the first time since it began in 1990), dropping in 87% of countries in 2020 and 51% in 2021 (UNDP, 2022), suggesting that declines in human capital will have longer-term effects.

2.2. Trade and industry

Global trade and financial markets experienced historic declines in 2020, followed by rapid recoveries in 2021. The economics literature describes far-reaching demand and supply shocks affecting nearly every industry in the first two-quarters of 2020 (Brodeur

[11] Please note: the claim that lockdowns and mobility restrictions were 'necessary' requires more critical debate and is outside the scope of this paper. The World Bank report (as with many reports and studies from international agencies) simply assumes this to be the case. Such reports rarely discuss which policies were necessary or unnecessary, appropriate or excessive.

[12] In contrast, younger age demographics, lower Covid restriction policy stringency and large agricultural economies in low-income countries helped buffer recession effects, while historic government spending programs occurred in high-income countries (Alon et al. 2022).

et al. 2021; Delardas et al. 2022; Goncalves and Moro, 2023; Panwar et al. 2022). This renewed debates about the nature of contemporary globalization, political economy and geopolitics (Schneider-Petsinger, 2023). According to UNCTAD (2022), global trade declined by an estimated 9% in 2020 but then quickly rebounded 13% higher than 2019 levels in 2021, outpacing more pessimistic predictions. A similar trend occurred with global foreign direct investment (UNCTAD, 2022), global manufacturing (UNIDO, 2022) and financial markets, although the rapid recovery is also believed to have increased volatility and systemic risk (Fang et al. 2023; Jana et al. 2022; Jebabli et al. 2022; Liu et al. 2022). Commodity prices (oil, metals, minerals) rose significantly right after the 2020 lockdown period, contributing to record-high price hikes and a global cost-of-living crisis (UNCTAD, 2022). Impacts were felt across all economic sectors in 2020-21: agriculture, energy, mining, construction, manufacturing, utilities, retail, finance, tourism and education (Delardas et al. 2022). Oil consumption reduced globally, reaching an estimated 18% decline in the United States in 2020 (Wang et al. 2022). Maritime trade (responsible for 80% of the global trade in goods) declined by 4% in 2020, leading to soaring freight costs, a global supply chain crisis and a reduction in the number of connected ports in non-lucrative markets (UNCTAD, 2022). The combination of supply and demand shocks and unprecedented government fiscal stimuli helped precipitate a 9% increase in global inflation in the second half of 2022, the highest level since 1995 (Hall et al. 2023; World Bank, 2023). The IMF (2023) predicts that global inflation will remain above pre-pandemic levels in 2023 (7%) and 2024 (4%).

2.3. Business

The *World Bank Business Pulse Survey* collected data from over 100,000 businesses worldwide and found 70% closed at the peak of the first wave and 25% remained closed 6 weeks into the crisis (Apedo-Amah et al. 2020). A second survey with businesses across 50 countries found that 15% remained closed in October 2020 (Facebook/OECD/World Bank, 2020). In the first half of 2020, nearly 50% of surveyed

businesses worldwide expected to fall into arrears within 6 months (World Bank, 2022)[13] and 19% reported laying off workers (Apedo-Amah et al. 2020). While varying by country and sector, firms experienced a 51% drop in revenue on average (highest in South Africa, Bangladesh, Nepal, Honduras, India, and Jordan), which remained at 40% reduced revenue 4 months into the crisis (World Bank, 2020). In Europe, Janzen and Radulescu (2022) found that lockdowns reduced sales growth by 63% while a study from India showed a 15% average drop in firm profits in 2020 (Jain and Kumar, 2023). Takeda et al. (2022) found that most small and medium-sized businesses (SMEs) recovered towards late 2020 in Asia, although certain hard-hit industries deteriorated (e.g. textiles, tourism, food and drink services and education). In general, research studies found that firms with more physical exposure to the public, less liquidity, more debt, lower productivity, younger age, female-headed and without a digital presence were hit hardest (Alekseev et al. 2023; Bozkurt et al. 2022; Cirera et al. 2021; Chang et al. 2022; Muzi et al. 2022). Trends of remote work are predicted to remain high in the years to come, shifting labor and business arrangements in the face of increasing automation and digitalization (Barry et al. 2022).

Lockdowns and other NPIs raised concerns about mass business failures. Although reviews have explored multiple impacts of the pandemic on business (Belitski et al. 2022; Brodeur et al. 2021), no meta-analysis exists that estimates worldwide business closures (known as *excess firm death*). The *Global Entrepreneurship Monitor* found early-stage entrepreneurial activity and established business ownership declined between 2021 and 2019 in ~60% of 34 sampled countries (Hill et al. 2022). Recent estimates of excess firm deaths in the USA vary between 185,000 to 330,000 in 2020 (Barnes and Edelberg 2022; Crane et al. 2022; Decker et al. 2022), disproportionately impacting small and medium-sized businesses (Fairlie et al. 2022) and higher in states with tighter restrictions (Dore and Mach, 2022). Across 17 European and Asian countries, Kalemli-Ozcan et al. (2022) estimated that an 8-week lockdown would increase failure by 9% in the absence of government support, rising to over 30% in hard-hit industries. Research from Japan

[13] According to the World Bank (2022), the average business had cash reserves for less than 51 days to cover basic expenses.

estimated a 20% increase in firm exists in 2020 compared to 2019 (Miyakawa et al. 2021) while a Chinese study found 18% of small and medium-sized businesses had permanently closed between February and May 2020 (Dai et al. 2021).

Governments responded to the crisis by introducing unprecedented fiscal stimulus programs. Research from the USA and Japan suggest these were not well targeted to smaller at-need businesses and had small overall effects on employment (Auerbach et al. 2022; Chodorow-Reich et al. 2022; Granja et al. 2022). Evidence from Latin America, Asia and Africa show that smaller and informal firms faced multiple barriers to accessing aid (Guerrero-Amezaga et al. 2022; Takeda et al. 2022; Aga and Maemir 2022); Wu (2023) found only 14% of firms across 10 developing countries received stimulus money.

Firm deaths (bankruptcies) were less than expected in the short-term in many higher income countries due to the rapid U-shaped recovery, government relief and a corresponding surge in new business entry in late 2020-2021. An estimated 1 million new firms were operational in late 2021 compared to 2019 in OECD countries with an estimated 450,000 more in the US alone (Economist, 2022). It is unclear why this occurred. Some economists have called the pandemic a form of "*creative destruction*" that has spurred self-employment and entrepreneurship; others are worried that large-scale government relief has upheld less productive 'zombie' firms that will rapidly fail now that state support has been withdrawn (Bruhn et al. 2021; Honda et al. 2023). Recent data from Germany and the UK show a backlog of insolvencies (Dorr et al. 2022; Witchell and Webster, 2023). Data from the EU shows that the last quarter of 2022 had the largest increase in bankruptcies since records began in 2015 (Eurostat, 2023b). Wu (2023) found that firms in developing countries who reopened in 2021 had increased fragilities, including higher debt and less liquidity. It is unclear how the economic shock of the pandemic will shape the economy in the years ahead.

2.4. Government spending and debt

Government fiscal intervention to manage the crisis led to historic levels of spending and debt accumulation that now threaten to drive large-scale public austerity (IMF, 2022;

World Bank, 2022). According to the IMF (2021), $18 trillion was spent by governments up to September 2021 (88% in advanced economies): $11 trillion in direct revenue and $7 trillion for business liquidity support.[14] Only 8% of spending ($1.5 trillion) was directed to the health sector. The fiscal response is estimated to have been equivalent to 20% of GDP in high-income countries, 10% in upper-middle income countries and <5% for lower-middle and low-income countries (World Bank, 2022).

Fiscal support precipitated the largest one-year increase in global debt since the Second World War, which rose 30% in 2020 to 263% of global GDP (Gaspar et al. 2022; Kose et al. 2021a,b). This increase was broad-based across private, public and household debt and the majority of countries, building on debt increases since the 2009 financial crisis. Government gross debt rose roughly 14% of GDP in high-income and upper-middle-income countries and 7% of GDP in lower-middle and low-income countries (World Bank, 2022). The crisis also led to the generation of new financial fragilities including deteriorations in country credit ratings, currency devaluations, liquidity problems and risk for debt defaulting and distress (World Bank, 2022).

The impact of fiscal measures are predicted to drive future government austerity in the context of a looming debt crisis (Kose et al. 2021b). Based on IMF projections, Kentikelenis and Stubbs (2022) estimated that 44% of countries (83 of 189) will face contractions in public spending in 2023, with 2.3 billion people exposed to budget cuts, mostly in middle-income countries (spending in low-income countries is predicted to stagnate). Others have predicted larger budget cuts (Ortiz and Cummins, 2021), directly associated with IMF Covid loans (Tamale, 2021). A recent World Bank-UNESCO (2022) report found 40% of low- and middle-income countries reduced education spending in 2020 (by 14% on average), which continued to remain below 2019 levels in 2022. Analysis by *The Commitment To Reducing Inequality Index 2022* found total spending on health decreased in 44% of countries between 2019 and 2021, while roughly half reduced education and social protection spending (Walker et al. 2022).

[14] This is likely a significant under-estimate. For example, a reported $11 trillion was spent by the US government alone during the crisis, only 5% of which was directed to the health sector, see: https://www.covidmoneytracker.org

3. Income and employment

3.1. Labour inequality

The pandemic recession in 2020-21 reversed the per capita income convergence of the last few decades, increasing global inequality and the wealth gap between and within countries (Adarov et al. 2022; ILO, 2022b, IMF, 2022; Narayan et al. 2022; World Bank, 2022). According to the *International Labour Organization* (ILO), workers lost roughly $6 trillion in direct income during 2020-22 compared to a 2019 baseline.[15] At the same time, the wealth of billionaires nearly doubled (Chancel et al. 2022), increasing by an estimated $4 trillion according to Oxfam (2022a,b). A 19% loss in global working hours occurred at the peak of worldwide lockdowns (ILO, 2021b).[16] Overall, ILO estimated a loss of 9% of global working hours and 114 million jobs in 2020, higher for women and young workers, and in Latin America and the Caribbean, Southern Europe and Southern Asia (ILO, 2021a). Self-reported survey data from 80 countries (subject to bias) suggests that employment for working age adults was 31% less than pre-pandemic levels in April-June 2020 (Brunckhorst et al. 2023). A full recovery stalled in 2021, mainly in lower-middle and low-income countries, with employment levels remaining an estimated 8% below prepandemic levels (Brunckhorst et al. 2023) and global working hours remaining 4% below (ILO, 2021b). Labor market impacts continued in late 2021 in low- and middle-income countries, including job displacement into lower paying jobs that were more informal and agriculture-based (Brunckhorst et al. 2023; He et al. 2023). According to a counter-factual analysis by the World Bank, at the end of 2021 there were still 40 million less jobs worldwide; in Pakistan alone, an estimated 1.6 million additional young adults were jobless (Schady et al. 2023). In the USA, an estimated 2.5 million workers were unable to work or worked at reduced hours in March 2022 because of Covid-related business losses or closures, down from 50 million in May 2020 (US Bureau of Labor Statistics, 2022). Real wage growth declined for the first time this century by 1.4% worldwide, according to ILO (2022b). While most higher-paid wage groups recovered to

[15] This total estimate is based on synthesizing results from ILO (2021a,b) and ILO (2022a,b), and does not account for government relief and assistance programs.
[16] In April 2020, the unemployment rate reached 14% in the United States; in Europe, 42 million people were dependent on job-retension schemes (Ebbinghaus and Lehner, 2022).

pre-pandemic levels, global employment levels among the lowest-paid group of workers remained below 2019 levels in 2022 (ILO, 2022b). There is evidence of a shift in the labour market, with an uneven recovery and lower-quality employment accounting for a large share of growth in developing countries (Narayan et al. 2022). Inequalities are now being compounded by inflation and the global cost-of-living crisis. Christensen et al. (2023) estimated that 1.7 billion workers worldwide have seen inflation outpace their wages in 2022.

The crisis reshaped class divisions between those able to work-from-home (teleworkers) and essential and non-essential workers. Reviews have explored the positives and negatives of teleworking on work-life-balance, work productivity and burnout (Newman et al. 2022; Shirmohammadi et al. 2022; Islam, 2022). According to the ILO (2021c), only 8% of workers worldwide worked from home prior to the pandemic, which rose to 17% (total 557 million people) during April-June 2020, and was highest in Canada (39%), Malaysia (36%), USA (35%) and UK (33%). This is roughly in line with other studies (Dingel and Neiman, 2020), including an analysis from Italy that showed 12% worked remotely in 2020, rising to 70% for employees of large firms (Crescenzi et al. 2022). The pandemic is predicted to increase work-from-home employment in the years ahead. Barrero et al. (2021) estimated that the percentage of remote workdays will rise from 5% to 20% in the USA post-pandemic. Some studies suggest that this will disproportionately increase professional opportunities for employees who are older, male and higher-educated (Bonacini et al. 2021).

The pandemic response also increased the risks of forced labour exploitation and modern slavery (Washburn et al. 2022), although the exact proportion is unclear. Private forced labour exploitation and sexual exploitation increased by an estimated 1.3 million and 1.5 million (to 27.6 million total) from 2016 to 2021 (ILO et al. 2022). Estimates suggest that 9 million additional children were at risk of being pushed into child labour by the end of 2022 (ILO and UNICEF, 2021), with emerging empirical data confirming an increase due to the pandemic response in some countries (Mohammed, 2023; Nuwematsiko et al. 2022).

3.2. Household income

The World Bank's *Poverty and Global Prosperity Report* (2022) estimated that global median income declined by 4% in 2020. Large-scale empirical surveys found that pandemic policies caused 30% to 65% of the global population to suffer financially in 2020 (Bundervoet et al. 2022; Egger et al. 2021; Khetan et al. 2022). The magnitude of income losses were substantial (Miguel and Mobarak, 2022), disproportionately affected lower income earners and countries (Chen et al. 2022; Khetan et al. 2022), and were associated with the stringency of public health policies (Hammond et al. 2022; Maredia et al. 2022). A large-scale World Bank study (n=41,000, 34 LMICs countries) found 64% of households reported decreased income and 36% stopped working during the first wave (42% of women lost their job, compared to 31% of men) (Bundervoet et al. 2022). This is roughly equivalent to other studies (Bottan et al. 2020; Egger et al. 2021; Kesar et al. 2021; Josephson et al. 2021; Wellcome, 2021). A retrospective survey across 16 countries found 32% reported suffering financially during the pandemic (higher in lower income countries) and included: job loss (8%), inability to meet essential needs (15%) and the use of savings (16%) (Khetan et al. 2022).[17] World Bank survey data suggests household income continued to be below pre-pandemic levels in 2021: 30% of respondents in high-income countries and 70% in low-income countries reported some income losses compared to pre-pandemic levels (World Bank, 2022; Brunckhorst et al. 2023). Longitudinal household data exploring the longer term effects of the lockdown recession and other NPIs are limited but show lingering impacts on household income and poverty (Jha and Lahoti, 2022; Mahmud and Riley, 2022; Rönkkö et al. 2022).

Individual research studies support the conclusion of a World Bank (2022) report: income losses were largest among youth, women, those in the informal sector, small business owners and casual workers (Bonaccorsi et al. 2021; Blundell et al. 2022; Barletta et al. 2022; Flor et al. 2022; Ge et al. 2022; Gummerson et al. 2021; Oyando et al. 2021; Richter and Patel, 2022; Schotte and Zizzamia, 2022). Some show larger adverse effects in urban areas, suggesting agricultural households were less negatively affected overall

[17] This study excluded low-income countries, where impacts reported by other surveys were more severe.

(Bundervoet et al. 2022; McDermott and Swinnen 2022). Few (1-15%) households in low- and middle-income countries (LMICs) received government or NGO assistance in 2020 (Egger et al. 2021; Maredia et al. 2022), although some data suggests this rose significantly in 2021 reaching an estimated 19% in low-income countries and 52% in upper-middle-income countries (Brunckhorst et al. 2023). According to Ratha et al. (2022), predictions that global remittances (worth $500 billion in 2019) would fall by 20% in 2020 did not occur (est growth rate +0.6%), although they declined by 8% in Africa and 7% in East Asia; however, the decline in informal transfers due to NPI restrictions means that the absolute reduction is likely much larger than official estimates (Dinarte et al. 2021).

3.3. Poverty

Global poverty increased for the first time in a generation in 2020 (Mahler et al. 2022; World Bank, 2022). Precise model estimates vary depending on the poverty metric used (Moyer et al. 2022; Sumner et al. 2022).[18] The most comprehensive estimates were provided by the World Bank's *Poverty and Shared Prosperity Report* 2022, using three different poverty lines to account for differences between countries. They estimated that 90 million fell into extreme poverty (<$2.15, used in low-income countries), 167 million fell below the $3.65 poverty line (used in low-middle income countries) and 152 million fell below the $6.85 poverty line (used in upper-middle income countries). This would suggest that 409 million more people were below one of three global poverty lines in 2020 due to the crisis. In an earlier analysis, Ferreira et al. (2021) estimated that 300 million fell into poverty in 2020 based on national poverty lines.[19] While some recovery occurred in 2021, current data suggests that food price increases and other factors stalled

[18] It is worth noting that nearly half of the global human population (over 3 billion people) live on less than $6.85 per day (World Bank, 2022).

[19] Another way to estimate global poverty is the societal poverty rate, which is a population-weighted average of the country-specific poverty line. The World Bank (2022) report does not provide a global estimate of changes in the societal poverty rate. The authors provided one on request; they estimated: 222 million people fell below the societal poverty line in 2020: 120 million in South Asia, 75 million in East Asia and the Pacific, 19 million in Sub-Saharan Africa, 10 million in the Middle East and North Africa, 8 million in Europe and Central Asia, 4 million in Latin America and the Caribbean and -13 million in the rest of the world (unpublished data, communication with the authors).

the recovery in 2022, with absolute numbers remaining roughly similar to those from 2020 (World Bank, 2022). Other analyses suggest larger increases in poverty. Laborde et al. (2021) estimated an additional 150 million people fell below the extreme poverty line in 2020 (a 20% increase), concentrated in urban areas of South Asia and sub-Saharan Africa. UNICEF (2021) estimated 100 million additional children were in multidimensional poverty in 2021, compared to 2019. Survey results from Maredia et al. (2022) suggested 19 million more people were living in extreme poverty in July 2020 in five African countries; by comparison, the World Bank (2022) analysis mentioned above estimated only 7.5 million fell into extreme poverty across all of Africa in 2020.[20] A recent report by Oxfam (2022a,b) estimated that 263 million more people (compared to 2019) were pushed into poverty by 2022 due to the combined impact of Covid and increases in inequality and food prices.

4. Food security

Hunger and food insecurity increased worldwide, with varying estimates across emerging and developing economies. According to the UN's flagship report, *The State of Food Security and Nutrition in the World* (FAO et al. 2022), 350 million more people were pushed into food insecurity from 2019 to 2021: 207 million became severely food insecure (especially in Africa) and 143 million moderately food insecurity. Food insecurity trends were increasing before the pandemic, however. A study by Balistreri et al. (2022) estimated that in 2020, 63% of an estimated 263 million additional food insecure people were due to the economic shock of the pandemic, and concentrated in Asia (India, Bangladesh, Pakistan), Sub-Saharan Africa and Latin America and the Caribbean. The study estimated 174 million more people remained food-insecure in 2021. *The Global Network Against Food Crises* (2022) estimated that 58 million more people (193 million total) were in acute food crisis or worse in 2021 compared to 2019, with 15 million more in emergency food crises (39 million total) and 460,000 more at

[20] These five countries account for 25% of the total population of Africa. Extrapolating the survey results from Maredia et al. (2022) would suggest 76 million people fell below the extreme poverty line in July 2020 in Africa. This is a very rough estimate but points to some of the methodological problems with understanding poverty impacts during the crisis.

famine levels (570,000 total). More than half of the increase in severe food insecurity was attributed to the pandemic economic shock. Additional estimates of increasing food insecurity were provided by Baquedano et al. (2021) and Laborde et al. (2021).

Empirical studies show that food access was disrupted much more significantly than food availability, due primarily to the recession and household socio-economic decline (Bene et al. 2021; McDermott and Swinnen, 2022; Vos et al. 2022). Large-scale surveys in low- and middle-income countries found that 45% of households were forced to miss or reduce meals during the 2020 lockdown period (Bundervoet et al. 2022; Egger et al. 2021), and that food insecurity was strongly associated with pandemic restrictions (Hammond et al. 2022).[21] Although most studies show a sharp initial decline followed by a gradual recovery (Rudin-Rush, 2022), food insecurity remained below 2019 levels in most studies (Bloem and Farris, 2022) and some research suggests declines continued in 2021 (Orjakor et al. 2023).

Food systems did show resilience in 2020, although the vast majority of small-scale farmers and those in the informal sector faced serious economic difficulties. Widespread and severe impacts occurred on food purchasing, sales and access to crop inputs and markets (Hammond et al. 2022). A review by Bene et al. (2021) noted that the pandemic redistributed food system profits away from small-scale outlets, markets and informal enterprises and towards larger grocery stores and supermarkets. According to the UN Food and Agricultural Organization, global food prices remained stable in 2020 but then rose sharply in early 2021, reaching their highest ever recorded level in 2022 (FAO, 2023), after having been compounded by the Russian-Ukranian war.[22]

[21] Methodological issues with pandemic phone-surveys and food security in Africa are discussed in Bruck and Regassa (2022).
[22] Diop and Asongu (2022) found that while both the Covid pandemic and Russian-Ukrainian war increased food prices across 25 fragile states, the war led to a much higher increase.

5. Education and learning loss

The pandemic crisis has been described as *"the most severe disruption to global education in history"*, with 1.6 billion students across 190 countries impacted in 2020 and in-person education closed for 141 days on average between 2020-2021 (UNICEF, 2022). An estimated 771 million children missed 1.5 years or more of school (Schady et al. 2023). A modeling study by UNICEF (2022) estimated a sharp 13% increase in global learning poverty, which rose from 57% in 2019 to 70% in 2022. They estimated that pandemic school closures led to 1 out of every 8 children in LMICs dropping into learning poverty, erasing all global educational gains achieved since 2000. Effects were largest in regions with the longest school closures including South Asia (average of 273 days) and Latin America and the Caribbean (average of 225 days).[23]

UNICEF's model assumes that one year of school closures is equivalent to 80-95% annual lost learning. A review by Moscoviz and Evans (2022) found that empirical studies showed less impact, although students from low socioeconomic households and in lower income countries suffered disproportionately.[24] A meta-analysis by Patrinos et al. (2022) found an average 0.17 standard deviation learning loss, roughly equivalent to one-half year of learning. A second by Betthäuser et al. (2022) found an average learning loss of 35% of a school year's worth of learning. However, most studies were from high-income countries. A study from Brazil found a 0.32 standard deviation decrease in test scores in 2020, equivalent to three-quarter of a year's worth of learning (Lichand et al. 2022), roughly equivalent to a study from South Africa (Ardington et al. 2021). An assessment by the World Bank estimated that 30 days of school closures led to 32 days of learning loss in low- and middle-income countries, which accounted for the erosion of

[23] Within these regions, there was substantial variation between countries. For example, schools were closed for 510 days in the Philippines, 448 days in Uganda and 326 days in Saudi Arabia; but only 47 days in Vietnam, 61 in Tanzania and 107 in Morocco (Schady et al. 2023).

[24] A large body of research has explored how educational systems adapted to remote schooling and the implication of this for post-pandemic education. It is worth noting, however, that an estimated two-thirds of children worldwide lack internet access at home (Schady et al. 2023). Research studies also question the effectiveness of remote learning even during short-term school closures in high-income countries (e.g. Netherlands) with high internet connectivity (Engzell et al. 2021).

previous learning (Schady et al. 2023). As noted by Schady et al. (2023), the 14.5 months of school closures in Bangladesh led to nearly 26 months of learning lost, when accounting for forgone learning and forgotten learning. Interestingly, a study in Swedish primary schools, which remained open, found no effect of the pandemic on reading comprehension scores (Hallin et al. 2022).

Early estimates by UNESCO (2020) predicted 24 million students were at risk of not returning to educational institutions in 2020 due to higher dropout rates and lower enrolment, especially in South and West Asia and sub-Saharan Africa: 11 million at primary and secondary levels, 8 million in tertiary education and 5 million in pre-primary. The only review of empirical data found dropout rates ranging from 1% to 35%, and highest for households with lower socioeconomic status, adolescents and females (Moscoviz and Evans 2022). For example, a study from Malawi found 14% of students did not return to school, rising to over 30% for girls aged 17-19 (Kidman et al. 2022). No recent comprehensive global estimate was available. A recent analysis found that 150,000 students (K-12) were unaccounted for and likely dropped out across 21 US states (Dee, 2023). A study from South Africa estimated an additional 725,000 learners were out of school in April/May 2021, four times larger than pre-pandemic years (Shepherd and Mohohlwane, 2022).

Learning loss and early school dropout are estimated to have long-term consequences. UNICEF (2022) called pandemic school closures an 'intergenerational inequality shock' and estimated the current generation of students may loss upwards of $21 trillion in earnings during their lifetime. Learning deficits could accumulate in Africa to more than 2 years of lost learning by grade 10 (Angrist et al. 2021), with intergenerational mobility in educational attainment decreasing by 10% (Neidhofer et al. 2022). Some data is more re-assurming; Singh et al. (2022) found that two-thirds of learning loss was made up within 6 months of schools reopening in Tamil Nadu, India.[25] De la Maisonneuve et al. (2022) estimated productivity losses built up over a lifetime of 0.4% to 2.1% after 45

[25] It is worth noting that Tamil Nadu has long had much higher overall social development scores compared to most other Indian states.

years; Fuchs-Schündeln et al. (2022) found average losses of 3.3%. A World Bank report suggested that children affeted by the pandemic, especially due to learning loss, could have earnings in adulthood that are roughly 25% lower than expected in the absence of pandemic disruptions (Schady et al. 2023).

6. Lifestyle changes

6.1. Sedentary behaviour

Multiple systematic reviews show reductions in physical activity across all age groups due to pandemic restrictions (Kharel et al. 2022; Larson et al. 2021; López-Valenciano et al. 2021; Oliveira et al. 2022; Stockwell et al. 2021; Wilms et al. 2022; Wunsch et al. 2022). Meta-analyses found average decreases in physical exercise among children in 2020 of 20% (Neville et al. 2022) and 26% (Chaabna et al. 2022), ranging from reductions of 11mins/day to 91mins/day compared to pre-pandemic levels (Rossi et al. 2021). Decreases in physical activity were greatest among children dependent on school and sports-based programs (Do et al. 2022) and in homes/neigbourhoods with less access to outdoor space (Liu et al. 2022; Yomoda and Kurita, 2021). Nature contact and soundscapes (noice levels) changed, with adverse consequences reported depending on the severity of restrictions and neighbourhood geography (Hasegawa and Lau, 2022; Labib et al. 2022). The transition to working from home may have increased muscoloskeletal disorders due to poor ergonomics (Cruz-Ausejo et al. 2022). Greater physical activity during the pandemic was associated with better mental health (Marconcin et al. 2022). There are few longitudinal studies currently available; one US study found that reductions in physical activity persisted into late 2021, after most restrictions were removed (Desine et al. 2023).

6.2. Sleep and screens

Lifestyle changes included sleep disturbances and increases in screen use and eye problems. A meta-analysis found a 41% global prevalence of sleep disturbances during 2020-21, higher during lockdown and for children and adolescents (Jahrami et al. 2022).

Sleep duration, quality and dream state were negatively affected (Drumheller and Fan, 2022; Gorgoni et al. 2022). An estimated 17% of people worldwide suffered from insomnia (14% moderate and 2.5% severe insomnia) (AlRasheed et al. 2022) which was associated with the level of NPI restrictions (Scarpelli et al. 2022). A meta-analysis by Madigan et al. (2022) found a 52% pooled increase in screen time among children (especially adolescents) in 2020, rising from 2.7 hours/day to 4.1 hours/day. Trott et al. (2022) found larger increases in primary aged children (1.4 hours/day) compared to adolescents and adults (~1 hour/day). Increases in screen use were associated with the stringency of lockdown (Kharel et al. 2022) and with risks for metabolic syndromes in adolescents (Musa et al. 2022). According to a small US study, screen use remained elevated by 1.1 hours/day in May-August 2021 (Hedderson et al. 2023). Increases in myopia (average 0.46 dioptre change) and other eye problems were found in systematic reviews, especially among children and those with pre-existing myopia (Abounoori et al. 2022; Cortes-Albornoz et al. 2022; Li et al. 2022).

6.3. Diet

Systematic reviews on diet show varied results. A review by Gonzalez-Monroy et al. (2021) found a decrease in healthy diets and increase in ultra-processed foods, while Mignogna et al. (2022) found improvements in nutritious food consumption, especially in some high-income countries. Pourghazi et al. (2022) found decreases in fruit and vegetable consumption among children. In general, studies show decreases in fast food but increased overall food intake, snacking, calorie-dense carbohydrates and sweets (Bakaloudi et al. 2022; Gligoric et al. 2022). Some negative dietary habits were maintained in the post-lockdown period (Mekanna et al. 2022). The large increase in food insecurity in low- and middle-income countries (LMICs) noted above drove many households to switch to cheaper and less nutritious (staples) foods, reducing dietary diversity, including less animal protein, legumes and nuts (Bloem and Farris, 2022; Picchioni et al. 2021). Exact estimates are unavailable. It is unclear what effects social distancing and lifestyle changes had on the human microbiome and the implications of reduced microbial diversity on human health (Finlay et al. 2021; Hurley et al. 2023).

6.4. Obesity

Pandemic lifestyle changes increased risks for obesity (Daniels et al. 2022). A review of longitudinal cohort studies by Anderson et al. (2023) found a 2% increase in childhood obesity and a 1% increase among adults in 2020 (low certainty evidence), as well as an average increase of 1.65 kg for children and 0.93 kg for adults. A study from the US found a 3% increase in adult obesity prevalence in 2020 compared to 2019 (Restrepo, 2022). In Israel, Shalitin et al. (2022) found that 11% of children with normal pre-pandemic weight became overweight or obese during 2020, highest in those 2-6 years old; in the US, Koebnick et al. (2022) showed larger weight gain among Black and Hispanic youth. Other reviews by Khan et al. (2022), Bakaloudi et al. (2022) and Chang et al. (2021) found that weight gain and body mass index (BMI) increases from pandemic confinements occured predominately among already overweight or obese people, including those with type 2 diabetes (Ojo et al. 2022). There is evidence that weight gain was maintained among children after most restrictions were removed in 2021, although no review was available (Azrak et al. 2022; Long et al. 2022; Siegel et al. 2022; Hernandez-Vasquez et al. 2022; Koebnick et al. 2022).

6.5. Child development

Research studies show adverse effects on child growth and development. A meta-analysis of 8 studies (all from high-income countries) found communication and personal-social impairments at age 12-months for children born in 2020 compared to pre-pandemic cohorts (Hessami et al. 2022). Other studies have shown reductions in early learning and motor skills (Byrne et al. 2023; Deoni et al. 2021). Since relative risk reductions were small in most studies, some have assumed impacts may be quickly reversed. One uncertainty relates to any possible increase in more severe disorders (e.g. autism spectrum disorder or schizophrenia), only noticeable in the future (Lavallee and Dumitriu 2022). Child development may have been adversely affected by the high rate of perinatal maternal depression and other related mental health deteriorations (Federica et al. 2023; Kokkinaki and Hatzidaki, 2022; Shorey et al. 2021), with some recent studies associating this with infant negative affect and temperament (Buthmann et al. 2022; Lopez-Morales

et al. 2022). Some studies suggest effects on early child development and socialization from mask wearing (Carnevali et al. 2022; Gori et al. 2021; Ramdani et al. 2022), although no comprehesive review was available. A study on school closures from Uruguay with children (4-6 years) found reductions in motor and cognitive development as well as attitudes towards learning compared to pre-pandemic cohorts (Gonzalez et al. 2022). A Chinese study found reductions in height growth after school closures (Wen et al. 2021).

Early modelling by Osendarp et al. (2021) and Headey and Ruel (2022) estimated that millions more children could suffer from wasting by 2022. However, there was no review available on childhood stunting and wasting and it is not possible to validate these model predictions with current data. Some empirical studies do show various negative effects (Alam et al. 2022; Jayatissa et al. 2021; Miller et al. 2022; Win et al. 2022; Zhu et al. 2022). Results from Win et al. (2022) suggest that food relief and rapid employment recovery likely helped to prevent severe population-level effects in Bangladesh.

6.6. Personality

Only a few studies have explored personality change during the pandemic. In the US, Sutin et al. (2022) found small declines in extraversion, openness, agreeableness and conscientiousness (2019-2022), equivalent to roughly one decade of normal personality change. Young people showed disrupted maturity (increased neuroticism, decreased agreeableness and conscientiousness). Interestingly, these changes were not apparent in the 2020 data but only emerged in 2021 and 2022. Smaller studies from Germany found slightly different results (Krautter et al. 2022; Rudolph and Zacher (2023). A review of personality type found neuroticism and anti-social personality traits were impacted more negatively during the crisis (Starcevic and Janca, 2022).

6.7. Frailty

Research also suggests an increase in frailty among the elderly, including various functional impairments (Hirose et al. 2023; Felipe et al. 2023; Saraiva et al. 2021; Richardson et al. 2022) and cognitive decline including a worsening of dementia (Noguchi et al. 2021; Prommas et al. 2022). Data on the magnitude of these effects were not readily available.

6.8. Addiction and drug use

A review of addiction disorders found that food, social media and internet addictions increased during the lockdown period (Alimoradi et al. 2022). Gaming addictions and disorders also appear to have increased among some children and adolescents (Han et al. 2022). Although alcohol, smoking and other drug use did not increase at a population-level in 2020, increases did occur in a proportion of the population, especially among those with addictive disorders (Marsden et al. 2022). A meta-analysis by Acuff et al. (2022) based on studies from 56 countries found alcohol consumption increased for 23% of people in 2020 and decreased for 23%. Some countries did experience overall increases (e.g. USA) while others (e.g. Australia) showed a decrease (Sohi et al. 2022). Heavy-drinking patterns intensified in some countries in 2020, with alcohol-related deaths increasing by 25%, 20% and 5% in the US, UK and Germany (Card-Gowers et al. 2021; Kilian et al. 2022a,b; White et a. 2022). Consumption of hard drugs, such as opioids, and drug-related mortality also increased in North America (Imtiaz et al. 2021; Simha et al. 2022). Similar trends occurred with smoking. A meta-analysis by Sarich et al. (2022) found 27% of people who smoked increased their smoking in 2020, while 21% decreased and 50% remained unchanged (2% of non-smokers started smoking). Almeda and Gómez-Gómez (2022) found an overall decrease in smoking. A review by Chong et al. (2022) found youth substance use (alcohol, cannabis, tobacco, e-cigarettes/vaping, and recreational drugs) declined in 2020, although increases were found among sub-groups (Layman et al. 2022).

7. Intimate relationships

7.1. Child abuse

Concerns that NPIs would increase child abuse and maltreatment (WHO, 2020) are in general supported by research findings, although the precise magnitude continues to be debated (Katz and Fallon, 2022; Klika et al. 2023). Research shows heterogenous results from different countries and unresolved discrepancies between a decrease in official reports and, in some studies, pediatric hospital visits and increases in self-reported abuse and risk factors (Klika et al. 2023; Letourneau et al. 2022). A meta-analysis by Lee and Kim (2022) estimated an 18% and 39% global prevalence of physical and psychological child abuse in 2020, both of which were greatest in low-income countries, but the limited number of studies and lack of baseline data prevented estimates regarding pandemic effects. Reviews by Huang et al. (2022) and Rapp et al. (2021) found increases in physical, psychological and sexual abuse. These analyses, and others (Katz et al. 2022; Marmor et al. 2021), suggest associations between increased child maltreatment and lockdown measures, a decline in official child maltreatment reporting and increases in the severity of reported cases. For example, Shusterman et al. (2022) found a 39% drop in child maltreatment reporting in 2020 in the United States, equivalent to 191,000 fewer reports, especially due to drops from educational personnel and daycare providers. Ribeiro et al. (2022) reported a 13% increase in requests for help in Portugal from child and adolescent victims in 2020 compared with 2019, which rose to a 101% increase during the lockdown period. Research from pediatric hospital studies are varied (Brown, 2022). In France, Obry et al. (2023) found a doubling of abusive infant head trauma during lockdown while Brown (2023) found a lag-time, with rates only increasing in 2021.

7.2. Domestic violence

Empirical data supports an increase in intimate partner violence (IPV), including emotional and sexual violence (Bhuptani et al. 2022; Macy, 2022; Thiel et al. 2022), as well as under-reporting in official police and emergency department records (Anderberg et al. 2022; Letourneau et al. 2022). This has been called the ‘shadow pandemic.’ In April

2020, modeling by the United Nations Population Fund (UNFPA) predicted 31 million additional IPV cases due to lockdown over 6 months, mostly in low- and middle-income countries. Data is currently unavailable to sufficienty evaluate this claim (Kim and Royle, 2023) and shortcomings of this model were discussed in Lokot et al. (2021). A meta-analysis by Piquero et al. (2021) based on early studies mostly from the United States found a 8% increase in IPV during lockdown and stay-at-home orders in 2020. A study across 13 LMICs by *UN Women* (2021) in mid-2021 found that 68% of women believed the incidence of physical or verbal abuse had increased during the pandemic. Studies from LMICs are limited. Research from India found a 135% increase in domestic violence complaints in May 2020 in districts with the strictest lockdown measures, which remained elevated in 2021 (Ravindran and Shah, 2023).[26]

7.3. Intimate relationships and family

Intimate partner and family relations experienced substantial stress during the crisis. Andrade et al. (2022), Bevan et al. (2023), Estlein et al. (2022) and Yates and Mantler (2023) reviewed a large body of qualitative research on changes to intimate family, sibling and romantic relationships, finding both positive and negative consequences, including increases in the care responsibility of women that widened gender inequality (Flor et al. 2022; Moyano et al. 2022). Pandemic restrictions had some negative impacts on the experience of new parents during pregnancy, childbirth and in newborn bonding and attachment (Adesanya et al. 2022; Zheng et al. 2022). No global systematic review was found on marriage and divorce rates. Data from the US (Manning and Payne, 2021; Westrick-Payne et al. 2022) and Japan (Ghaznavi et al. 2022; Komura and Ogawa 2022) found that new marriages in 2020 reduced by 10% while divorce rates declined by 12% (US) and 27% (Japan). According to the *International Labour Organization* (ILO) et al. (2022), the number of forced marriages rose globally by nearly 7 million between 2016 and 2021, to 22 million; however, data on specific pandemic-related increases were unavailable. Child marriages likely rose. Predictions by UNFPA in early 2020 estimated

[26] This study also found a decrease in rape and sexual assault complaints, which they ascribed to reductions in human mobility, although reporting issues may also be involved.

that child marriages would increase by upwards of 13 million (UNICEF, 2021). Yukich et al. (2021) modeled increases in five countries responsible for 50% of all child marriages (Bangladesh, Brazil, Ethiopia, India, and Nigeria) and estimated that total global increases until 2035 would range from 3.6 to 10 million. Empirical data remain sparse (Esho et al. 2022), which complicates current estimates (Lokot et al. 2021).

7.4. Fertility and sex

Research from high-income countries suggests that a drop in birth rates occurred in some countries during the pandemic. Other data show that sexual activity among women reduced significantly and unwanted pregnancies likely increased. Pomar et al. (2022) found a 14% reduction in live births in January 2021 across 24 European countries, associated with the stringency of lockdown (no reduction occurred in Sweden). Sobotka et al. (2022) analyzed birth trends across 37 high-income countries and found two short-term reductions in births, in January 2021 and early 2022. They hypothesize that the pandemic may have small but lasting effects on fertility rates, depending on future economic recovery. Wolff and Mykhnenko (2023) found a 4% drop in births across 900 European cities in 2020. A US study found that declines in birth rates were associated with the stringency of NPIs, and were higher in democrat-controlled states (Adelman et al. 2023). Silverio-Murillo et al. (2023) found a 12% reduction in fertility in Mexico, which returned to pre-pandemic levels by end of 2021. Some data suggests fertility declines were disproportionately among wealthier and older women (Mooi-Reci et al. 2022; Silverman et al. 2022). No review was available, however.

Consistent reductions in women's sexual activity was reported across multiple systematic reviews, with most reporting decreases in sexual intercourse and increases in solitary sexual behavior (de Oliveira and Carvalho, 2021; Toldam et al. 2022; Hessami et al. 2022; Gleason et al. 2022). Individual studies found an increase in sex toy sales (Qalati et al. 2022) and pornography use (Lau et al. 2021). Reviews have also found small reported changes in menstrual cycles (Tayyaba Rehan et al. 2022), erectile dysfunction (Bakr and

El-Sakka, 2022) and earlier average onset and progress of puberty among girls (Prosperi et al. 2022). No review was available on sexual activity outside the home during lockdown; however, a UK study found 10% of respondents reported disobeying lockdown rules to have sex with someone outside their household (Maxwell et al. 2022).

Early estimates by UNFPA suggested that upwards of 15 million additional unwanted pregnancies would occur across 132 low- and middle-income countries (LMICs), based on a 10% drop in sexual and reproductive health services (Riley et al. 2020). This was revised in January 2021 after data suggested much lower disruptions to family planning services; UNFPA (2021) then estimated only 1.4 million unintended pregnancies across 115 LMICs (range 500,000 to 2.7 million). This lower estimate assumed an average of 12 million women (range 4 to 23 million) were unable to access family planning services, mostly during the first 4 months of the pandemic. However, there are few studies available to evaluate these estimates. Some studies show reductions in fertility intention (Rahman et al. 2022) while others found increases in unwanted pregnancies (Druetz et al. 2022; Molla et al. 2022). A few studies show drops in abortion during lockdown including a 25% decline in Italy and 40% decline in Mexico, suggesting a reduction in unwanted pregnancies in some countries (Marquez-Padilla and Saavedra 2022; Guzzetti et al. 2022).

8. Community

8.1. Social relationships

A large body of research during the pandemic focused on how to promote compliance with public health recommendations by altering social norms and interactions; however, much less is known about their adverse effects on social relationships. The crisis functioned as a *social shock* disrupting social networks, support, interaction and intimacy, and reshaping cultural etiquettes and routines of work, school, care, social life and meaningful events (e.g. marriage, birth, adulthood, illness and death) (Lannutti and Bevan, 2022; Long et al. 2022). Quantitative data on changes to social relationships are limited. A review by Buecker and Horstmann (2021) found increases in loneliness

compared to pre-pandemic data and a deterioration in the quality of social relationships. Despite a transition to digital platforms, longitudinal data from 23 countries showed that online connection did not address feelings of loneliness and isolation for most people (Van Breen et al. 2022). Qualitative reviews have been published on specific changes; for example, the adverse consequences of blanket hospital visitation policies (Iness et al. 2022), restrictions at long-term care facilities (Saad et al. 2022; Veiga-Seijo et al. 2022) and regulations associated with mourning and funerals (MacNeil et al. 2021; Van Schaik et al. 2022). Some studies from North America and Europe suggest a decline in adolescent and young adult interpersonal connections and friendship (Kulcar et al. 2022; Kozak et al. 2023; Lowe et al. 2023; Smith et al. 2022); however, others suggest some strenghtening effects (Juvonen et al. 2022; Lee et al. 2023). A longitudinal US study found decreased feelings of friendship and increased social hostility in May 2020 compared to pre-pandemic data (Philpot et al. 2021). Two studies from the Netherlands found that social networks became smaller and more focused on family ties in 2020 (Steijvers et al. 2022; Volker, 2023). A longitudinal qualitative study from the UK and Colombia found that a *belongingness gap* emerged and persisted among roughly one-third of older adults, who also experienced a loss of autonomy (Derrer-Merk et al. 2022a,b). Reduced social contact was especially difficult for more vulnerable populations, including people with disabilities and the elderly (de Vries et al. 2022; Li et al. 2023), as well as young families (Zeduri et al. 2022). Although research is limited, some studies suggest that posttraumatic growth may be inhibited by the increase in social isolation that occurred during the pandemic period (Collazo-Castineira et al. 2022; Matos et al. 2021; Ulset et al. 2022).

8.2. Stigma

The crisis generated negative psychosocial reactions, partially driven by media narratives, heightened fear and social conformity to NPI rules. A meta-analysis found 35% of people had experienced some form of stigma and social stereotyping and avoidance, higher among Covid patients, those with lower income and health care workers (Yuan et al. 2022). Another review explored heightened xenophobia among migrants (Silva et al. 2022). Although no review is available, individual studies suggest that social pressure to

conform to NPI rules played a role in stigma as well as hostile vigilantism (Biswas et al. 2021; Doucet et al. 2022; Graso et a. 2022; Peters et al. 2022; Tei and Fujino, 2022). Studies on media representations from Canada and the UK found a strong moralization discourse that blamed and shamed specific groups (e.g. Asians, young people, non-conforming individuals) and divided the population into: "the virtuous" rule followers (considered selfless and smart) and the deviants (e.g. Covidiots; immoral, stupid and selfish), who questioned or criticized the NPI rules and/or did not respect the rules (Capurro et al. 2022; Lennon and Gill, 2022; Labbe et al. 2022). Other studies have explored the emergence of *essentialism* in public discourse: children were framed "as a risk" (e.g. vector) rather than at risk of adverse consequences from NPIs (Ciotti et al. 2022) and the elderly were framed as a homogenous group of "vulnerable" people, reinforcing prolonged isolation and paternalism (Derrer-Merk et al. 2022b).

8.3. Mobility

Pandemic policies led to changes in every-day mobility and international and domestic migration flows. Over 100,000 international travel restrictions were implemented globally in 2020, with significant impacts on economic migrants, asylum seekers, refugees, international students and others (McAuliffe and Triandafyllidou, 2021). No comprehensive review or meta-analysis was available on this topic. An analysis of 15 advanced economies found declines in immigration in 2020 in all but Finland, highest in Australia (60%), Spain (45%) and Sweden (36%) (Gonzalez-Leonardo et al. 2023). NPIs also had variable effects on human mobility patterns across and within countries. Geospatial studies show less reductions in mobility in lower-income areas with higher population density and more informal livelihoods; this is sometimes refered to as the "luxury of social distancing" (Castells-Quintana et al. 2021; Long and Ren, 2022; Jiang et al. 2022). Some research from North America suggest that mobility reductions were short-lived (only 3-6 weeks) despite them remaining legally in place for much longer (Navazi et al. 2022). Lockdown conditions were particularly difficult for internal migrants, which are estimated at 100 million in India alone, many of which were unable to return home and placed into relief camps with poor living conditions (Jeslilne et al.

2021). Using Google data from 124 countries, Czech et al. (2021) found that countries with a higher *Human Development Index* (HDI) had greater internal human mobility reductions in 2020-21 compared to countries with a lower HDI.

Anecdotal reports of an *urban exodus* are supported by research findings in some countries. A large-scale analysis of European cities found that population growth slowed to -0.03% in 2020, with 28% of cities experiencing significant population loss due to reduced in/out-migration (773,000), excess deaths (300,000) and lower births (4%, ~150,000) (Wolff and Mykhnenko, 2023). A study of 62 cities across North America found that only 27% of downtown cores had recovered to 75% of their pre-pandemic mobility levels in May 2022, with 44% remaining 50% or below (Chapple et al. 2022). Mobility reductions were highest for larger vs medium cities and those in the north vs southern cities. While some studies suggest this trend may be temporary (Gonzalez-Leonardo et al. 2023; Rowe et al. 2023), others suggest urban flight from downtown cores will continue, partially due to inflated property markets and work-from-home trends (Borsellino et al. 2022; Colomb and Gallent, 2022; Gupta et al. 2022; Kotsubo and Nakaya, 2022). Data from the US (2021-22) show large out-migration in California and New York (with more restrictive NPIs) and in-migration in Florida and Texas, which had less restrictive NPIs (Zinberg et al. 2023).

8.4. Crime

No systematic review was available on crime and law enforcement. Across 23 countries, Nivette et al. (2021) found an average 37% reduction in police-recorded crime during the 2020 lockdown period, with larger reductions associated with more stringent movement policies. While property-based crimes decreased, homicide was relatively unchanged and crime increased to pre-Covid levels after lockdown in mid-2020. Other studies have been country and/or issue specific. The homicide rate in the US increased by 45% from 2019 to 2021 (equilavent to 6,000 additional deaths in 2021 alone) (Kegler et al. 2022; Murray and Davies, 2022; Simon et al. 2022). Massenkoff and Chalfin (2022) found that although most violent crimes declined in the US, the risk of street crime (robbery and

assault) actually rose 15-30% in 2020. Studies from India found lockdowns directly and indirectly contributed to increased property crime and missing person cases (Paramasivan et al. 2022a,b). A qualitative study from Nigeria found that crime increased due to the economic crisis in 2020 (Ardo et al. 2022).

There is evidence of a global increase in cybercriminal activity (Buil-Gil et al. 2021; Regalado et al. 2022) and online and financial fraud, especially related to historic government assistance programmes (Levi and Smith, 2022; Valiquette L'Heureux, 2022; Zhang et al. 2022). Griffin et al. (2022) estimated 10-15% of loans from the $800 billion Paycheck Protection Program (PPP) in the US, a relief program for businesses (operational from April 2020-May 2021), engaged in potential fraud. It is unclear how much of the total $6 trillion spent by the US government was misappropriated by fraudsters. Although there are major concerns that the pandemic led to a rise in corruption, including in the healthcare sector (Teremetskyi et al. 2021), there is a lack of data available for analysis (Moya-Espinoza, et al. 2022).

Pandemic policies also criminalized social behaviour and expanded police powers to arrest and fine the public for non-complance. Again, no review was available. An *Amnesty International* (2020) report documented police abuses across 60 countries, including allegedly detaining 85,000 people for non-compliance with curfew in the Dominican Republic and 100,000 in the Philippines. The *Policing the Pandemic Mapping Project* found over 10,000 Covid police enforcement incidents across Canada in the first half of 2020 (totaling $13 million in fines) related to social distancing rules (McClelland and Luscombe, 2021). Studies from Argentina, Nigeria and Australia highlight increases in "resistance to authorities" arrests, growing distrust of police due to selective enforcement and corruption and police discrimination (Shodunke 2022; Perez-Vincent et al. 2021; Russell et al. 2022).

8.5. The legal system

Covid policies impacted the criminal and legal justice system, although the available data is limited. A unique study by Godfrey et al. (2022) from the UK found a backlog of half-

a-million court cases in May 2021, with outstanding Crown cases increasing by 30% from a 2019 baseline. They noted the substantial impact on all court users of this backlog: victims, witnesses and defendants, the legal professions, and overall public trust in the law system. A study from Brazil also found a large increase in court backlogs (Castelliano et al. 2021). Other studies have explored the impact of the crisis on policing (Maskaly et al. 2021; Martin et al. 2022) and norms in jurisprudence (Berger, 2022). Less than 6% of the global prison population benefited from efforts during the first Covid wave to promote decarceration to prevent infection; studies have shown a severe deterioration in global prison system conditions in 2020, including increases in solitary confinement and prison riots (Buchanan et al. 2020; Johnson et al. 2021; Maruna et al. 2022; Penal Reform International, 2021).

8.6. Trust

Trust has been a central concept during the crisis, although only one early review was available (Devine et al. 2021). Most research has focused on the correlates of trust for compliance and disease control (Bollyky et al. 2022; Sulik et al. 2021) rather than longitudinal societal trends. There are significant methodological problems with trust measurement and analysis that have been discussed (Brosius et al. 2022; Wollebaek et al. 2021). Nonetheless, some general trends are discernable. A meta-analysis of surveys across 27 high-income countries in 2020-21 found trust in government increased by roughly 4% (to 44%) whereas support for democracy declined by the same amount (to 65%) (Foa et al. 2022). According to the *Wellcome Global Monitor Project*, high degrees of trust in science (41% of respondents) and scientists (43%) increased worldwide by 10%, comparing 2018 with late 2020, whereas trust in ones neighbours (29%) decreased by 5% (Wellcome, 2021). An analysis of data from 46 countries found that average trust in media increased by 6% (44% reported they trust news most of the time) (Newman et al. 2021).

Heightened trust in 2020 contributed to a ‘rally-around-the-flag’ effect (Bol et al. 2021), increasing trust in political leaders, healthcare workers, the media and scientific experts

(Algan et al. 2021), partially associated with public levels of fear (Eggers et al. 2022; Van der Meer et al. 2023). However, increased political discontent, perceptions of competence and economic concerns decreased trust over time in 2020, which has been shown to have been associated with socio-economic status, personality type and political affiliation (Algan et al. 2021; Bromme et al. 2022; Gualano et al. 2022; Graffigna et al. 2021l; Davies et al. 2021; Nielsen et al. 2021; Jorgensen et al. 2022; Starevic et al. 2022; Wu et al. 2022). A longitudinal Canadian study found those who had *less* trust in society before the pandemic lost more trust (roughly 20% of respondents, correlated with lower socio-economic status) while those with *more* pre-existing trust (typically with higher socio-economic status) *gained* more trust (Wu et al. 2022). There are few studies about public perceptions of scientific policy advice during the crisis (Schultz and Ward, 2021). Pandemic policies have also contributed to increases in social polarization, although no review was available; a survey by PEW found 61% of respondents across 19 countries believed their country was more divided in 2022 compared to prior to the pandemic (rising to >70% in USA, Netherlands, Germany, Canada and France), compared to 32% who believed society was more united (highest in Singapore, Sweden and Malaysia). A large-body of research has explored the associations between low social and political trust and alternative explanations (or conspiracy theories) during the pandemic (Tsamakis et a. 2022; van Mulukom et al. 2022). The influence of public health restrictions in driving social polarization and distrust is not well characterized in the academic literature.

8.7. Mass protests

According to a global assessment by the *Armed Conflict Location and Event Data Project* (ACLED, 2021; 2022), public demonstration activities rose globally by 3% in 2020 (vs. 2019) and 9% in 2021 (vs. 2020). While the first four months of the pandemic (lockdown period) saw a 35% drop, this was followed by quick reversals and overall increases especially in anti-government protests and, in the US, Black Lives Matter protests in the summer of 2020. An estimated 19% of global protests were pandemic-related in 2020, and 16% in 2021 (with significant increases in Europe). Studies in

Germany found 20% of people were sympathetic to anti-containment protests and 10% had participated (Hunger et al. 2023; Borbath, 2023). However other studies suggest that polling data has over-simplified public support for lockdown and other NPIs and under-emphasised concerns about their side effects (Foad et al. 2021). Covid-related protests continued in early 2022 in North America and Europe, initially sparked by the *Canadian Freedom Convoy*. The pandemic's indirect effects on protest movements and civil unrest may also play out in the medium term (Bank et al. 2022).

8.8. Media

Research has generally shown that the pandemic increased public consumption of media while also challenging journalistic standards and exacerbating threats to media freedom, including in established democracies (Edgell et al. 2021; Papadopoulou and Maniou, 2021; Pajnik and Hrzenjak, 2022; Holtz-Bacha, 2022). Media watchdogs, such as the *International Press Institute*, documented incidents of verbal and physical attacks, arrests and criminal investigations, information restrictions, censorship, and excessive fake news regulation (Palmer, 2022; Pomeranz and Schwid, 2021).[27] The weakening of press independence also occurred through new economic pressures, which saw significant job insecurity, declining advertising revenue, outlet closures and dependence on government funding, which some studies suggest was disproportionately available to pro-government outlets (Holtz-Bacha, 2022; Papadopoulou and Maniou, 2021; Libert et al. 2022; Posetti et al. 2020; Santos and Mare, 2021).

Studies show an increase in global news consumption in 2020, mainly for TV news (including live briefings), social media and Internet news (Mihelj et al. 2022; Newman et al. 2021; Van Aelst et al. 2021). Increases in media use were associated with a decline in mental health (Strasser et al. 2022; Marciano et al. 2022). Studies generally show that political sources dominated the crisis reporting, revealing the central influence of the state and biomedical experts in constructing pandemic news, with some indication that critical scrutiny of policy decisions were minimal (Matthews et al. 2023; Mellado et al.

[27] See: https://ipi.media/covid-19-tracker-in-graphics/

2021; Morani et al. 2022). A review of risk communication found that uncertainty was not adequately communicated to the public in the early stages of the pandemic (Ratcliff et al. 2022) while some research also shows widespread inadequacies in journalistic reporting of epidemiological data (Ratcliff et al. 2022). There was a sharp decline in print newspapers, especially local outlets, due to lockdown and fears about infection control. Some studies suggest this may hasten the demise of printed newspapers and local and/or small-scale news outlets (Santos and Mare, 2021; Mihelj et al. 2022; Newman et al. 2021; Van Aelst et al. 2021).

There is wide agreement that the crisis represented a pivotal moment for digital journalism (Quandt and Wahl-Jorgensen, 2021; Papadopoulou and Maniou, 2021). The pandemic response involved unprecedeted steps at controlling the spread of online information with warning labels, bans and removal for 'misinformation' (Krishnan et al. 2021); a large-body of research has been focused on the psychology of misinformation susceptibility (Chu et al. 2022; Nan et al. 2022; Yu et al. 2022). However, recent scientific data shows that the alarmist narrative about misinformation has been overblown (Altay et al. 2023). One large-scale analysis found that only 2% of web traffic and 14% of Facebook engagement in 2020 went to untrustworthy news outlets (Altay et al. 2022).[28] The dominant framing of the 'infodemic' appears to have provided a cover for governments to strengthened misinformation laws, censorship and Internet blackouts (Rodrigues and Xu, 2020; Pomeranz and Schwid, 2021), which may have long-term effects on media independence and free speech.

8.9. Elections and political attitudes

According to the *International Institute for Democracy and Electoral Assistance* (IDEA), at least 80 countries postponed elections, mostly in 2020. Of 108 elections, 66% had lower voter turnout in 2020-21 with a 10% mean decline (declines >20% in Venezuela, Iran, Kyrgyzstan, Benin, Bahamas, Central African Republic, Hong Kong, Gibraltar, Syria); 34% had higher turnouts (8% mean increase, >20% in Togo and Zambia) (IDEA,

[28] The authors rely on the News Guard rating system, and acknowledge that "sharp, binary distinctions between trustworthy and untrustworthy sources are fraught, and people will have strong views about how some brands are labeled."

2022). Various studies have explored impacts of the crisis on political campaigning and voter sentiment, although no review was available. Some studies from France and the US suggest restrictions led the public to rally around the incumbent politician or 'safe candidates' (Bisbee and Honig, 2022; Giommoni and Loumean, 2022). Research has found different results regarding the pandemic's effect on the 2020 US election (Mitchell, 2022; Algara et al. 2022) and populism (Bayerlein and Metten, 2022). In some cases Covid restrictions were used as a pretense for the arbitrary detention of opposition candidate (Oswald, 2021). A body of research suggests heightened fear was associated with increases in authoritarian attitudes and political orientation (Filsinger and Freitag, 2022; Graso et al. 2022; Hirsch, 2022; Volk and Weisskircher, 2023; Winter et al. 2022). Political scientists have also highlighted the potential impacts on public sentiment related to globalization, expanding state power and trust in multilateral institutions (Bieber 2022; Ciravegna and Michailova, 2022).

9. Environment and ecosystems

Reviews on the environmental effects of the pandemic response show both positive and negative consequences for global ecosystems (Bates et al. 2021; Jiang et al. 2022; Primack et al. 2021). Air pollution and greenhouse gas (GHG) emissions reduced significantly during the lockdown period (Bakola et al. 2022). However, the overall growth rates of greenhouse gases did not decrease and increases in methane and ozone occurred in 2020-21, the reasons for which are still not fully understood (Laughner et al. 2021; Guevara et al. 2022; Qu et al. 2022). Ecological studies found some transient improvements for wildlife populations and natural ecosystems, sometimes referred to as the '*anthropopause*' (Manenti et al. 2020; Soto et al. 2021; Warrington et al. 2022). However, other studies have shown adverse consequences. Souza et al. (2021) found that public interest in national parks declined globally due to mobility restrictions and park closures, reducing revenue and increasing vulnerability to development pressures. In Italy, Manenti et al. (2020) found that invasive species increased during lockdown due to reduced wildlife conservation and management activities. Although no review was available, studies from India and Nepal showed increased wildlife hunting and poaching

during lockdown (Aditya et al. 2021; Behera et al. 2022; Koju et al. 2021). Some studies have also found increases in illegal forestry practices (Tleimat et al. 2022) and illegal commercial and recreational fishing (Ben et al. 2022; Quimbayo et al. 2022). A large-scale study found that deforestation trends did not deviate from historical projections in the Americas and Asia in 2020, although increases were found in Peru and Africa (Cespedes et al. 2022).

A number of studies suggest that the pandemic reversed a decade-long momentum to reduce plastic waste pollution (Li et al. 2022; Peng et al. 2021; Yuan et al. 2021). Precise effects on global plastic pollution are unclear due to data limitations, although there is agreement that personal protective equipment (PPE) waste and single use plastics substantially increased. Peng et al. (2021) estimated more than 8 million tons of mis-managed pandemic-associated plastic waste was generated by mid-2021 (especially from hospital medical waste, and from Asia), and that 26,000 tons were discharged into the ocean (representing 1.5% of all riverine plastic discharge). However the OECD's (2022) *Global Plastic Outlook* analysis estimated that plastics declined worldwide by 4.5% in 2020, equivalent to 10 million less tons. The analysis found that declines were largely driven by the economic contraction in manufacturing and construction; by comparison, they found that household plastic use, medical waste and municipal waste increased; they also found that recycling and waste management was negatively impacted (OECD, 2022).[29] Precise estimates of the number of face masks used in 2020 also vary widely, from 450 billion (Li et al. 2022) to 126 billion (OECD, 2022). A number of studies raise concerns about the increased discharge of micro-plastics from PPE and medical waste into aquatic ecosystems (OECD, 2022; Peng et al. 2021; Oliveira et al. 2023) as well as the health and environmental consequences of an increase in the use of various disinfectant chemicals, especially for children (Dewey et al. 2021).

[29] The two estimates by Peng et al. (2021) and OECD (2022) are not necessarily mutually exclusive; it is possible that the decline of plastics in manufacturing (10 million tons, as estimated by OECD, 2022) was offset by the growth of plastics in the medical sector (8 million tons) (as estimated by Peng et al. 2021).

10. Governance

10.1 Political violence

Security experts predicted a rise in violent conflict and insecurity in 2020, although others hoped the crisis would promote global ceasefires (Basedau and Deitch, 2021). According to the *Armed Conflict Location and Event Data Project* (ACLED, 2021, 2022), total worldwide political violence decreased by 16% in 2020 and 17% in 2021 compared to 2019, although few conflicts ended. However, this aggregated data hides significant worsening of conflict dynamics in Southeast Asia, Africa and South America and shifts in the activity of non-state actors, who appear to have used the crisis to their advantage (ACLED, 2021; Ide, 2021). Studies consistently found increased political violence in Africa (Bank et al. 2022; Gutiérrez-Romero 2022); according to ACLED (2021), violent conflict in Africa rose by 40% in 2020 and 48% in 2021 compared to 2019. Violence against civilians by state military and police forces increased during lockdown (Bank et al. 2022); a rise in coup attempts (known as '*Covid coups'*) and succesful coups was reported by Chin (2021). While the exact contribution of the pandemic response is hard to isolate (Basedau and Deitch, 2021; Hanieh and Ziadah, 2022; Hilhorst and Mena, 2021) the crisis does appear to have played some role in igniting coups (e.g. Tunisia) and armed conflict (e.g. Ethiopia) (Bank et al. 2022; Chin, 2021) and increasing vulnerabilities in ongoing conflict zones (e.g. Afghanistan and Yemen) (Rahmat et al. 2022; Islam et al. 2022). The legacy of the pandemic response and ongoing global economic crisis may increase conflict and instability in the years ahead (Basedau and Deitch, 2021).

10.2. Democracy and freedom

According to *The Economist's Democracy Index* (2020), the world experienced the largest rollback of individual freedom in 2020 *"ever undertaken by governments during peacetime (and perhaps even wartime)."* The index found that 70% of countries experienced declines in governance scores due primarily to government-imposed restrictions. Analysis by *Freedom House* (2021) also found the largest annual decline in democracy and freedom of the last two decades: 73 countries experienced declines in

2020 while only 28 showed improvements.[30] This downward trend continued in 2021 (Boese et al. 2022; Democracy Index, 2021). Other measurements, such as the *Human Development Index* (2022) and the *Ibrahim Index of African Governance* (2023), show declining or stagnating progress in governance since 2019. Analysis of the *Pandemic Violations of Democratic Standards Index* across 144 countries found most governments engaged in some violation of democratic standards in 2020 (Edgell et al. 2021): roughly 70% implemented restrictions on media freedom, 50% engaged in abusive enforcement, 40% did not have time limits on states of emergency, 30% engaged in official disinformation campaigns, 20% limited the legislature, 20% engaged in discrimination measures and 10% suppressed non-derogable rights. A large-scale meta-analysis of public surveys across 27 countries in 2020-21 found an erosion of support for core democratic attitudes (Foa et al. 2022). Some studies suggest that fear played a fundamental role in driving public acceptance for civil liberty restrictions (Vasilopoulos et al. 2022). Reviews of the legal basis for pandemic states of emergency have found that they sometimes went *against* legal precedence and expanded executive power (Grogan 2022; Bjørnskov and Voigt, 2022); however, courts, legislatures and sub-national governments did employ some checks and balances on executive power (Ginsburg and Versteeg, 2021).

According to *Transparency International* (2022), 27 countries had historically low progress fighting public sector corruption in 2021. Some studies show a reduction in government transparency and violation in laws ensuring public access to information (Cifuentes-Faura, 2022; Marti, 2022). The crisis opened up opportunities to abuse state resources for political and financial gain (Guasti and Bustikova, 2022) as well as for lobbying and corporate influence, although this is not well characterized in the academic literature.

[30] Between 2019 and 2021, the percentage of 'free countries' and 'partly free countries' dropped 1% and 3% while 'not free countries' rose 4%. An estimated 156 million people living in partly free countries were downgraded to not free while 1.48 billion people transitioned from free to partly free, largely due to the historic downgrading of India.

10.3. Human rights

Covid policies generated a large body of descriptive work on how they adversely impacted basic human rights including restrictions to individual freedom of movement and assembly (Chiozza and King 2022). The *Human Rights Measurement Initiative* found that nearly all of 39 sampled countries experienced declines in respect for human rights in 2020 (Clay et al. 2022). In total, 89% of human rights practitioners noted decreases in economic and social rights (work, education, food, health, housing), 82% in civil liberties (freedom of assembly, expression and political participation) and 63% in physical intregrity rights (freedom from torture, arbitrary arrest, and disappareance). A review on human rights and Covid policies in Africa noted the exclusion of vulnerable people from policy decisions and increased socio-economic vulnerability and precarity (Manderson et al. 2022). A survey by *Amnesty International* (2021) across civil society groups in 28 countries emphasized the increase in criminalization, stigma and discrimination experienced by socially marginalized people due to pandemic restrictions. A review of emergency orders from 39 countries found half included criminal sactions for lockdown violations, and few fully complied with human rights legal requirements (Sun et al. 2022). Research has also highlighted the negative human rights implications of new mass surveillance technologies (e.g. digital health passes used as part of track and trace systems in China) and use of data for financial profit, known as 'datafication' (Boersma et al. 2022).

10.4. Scientific advice and research

The pandemic response involved an unprecedented expansion of scientific advice and research into crisis management and everyday life. While no comprehensive meta-study was available, four main consequences are worth noting from the literature, mostly from high-income countries. First, policy studies from 2020 largely agree that Covid task forces over-represented biomedical experts and excluded many forms of scientific expertise, including in mental health, ethics and economics (Bruat et al. 2022; Colman et al. 2021; Camporesi et al. 2022; Mulgan et al. 2022; Rajan et al. 2020; Pykett et al. 2022; Wenham and Herten-Crabb, 2021). In many countries, power was concentrated in a

select number of science advisors who disproportionately shaped policy and public narratives, revealing the inadequacies of ad hoc science advisory mechanisms (Pielke, 2023; Rangel et al. 2022; van Dorren and Noordegraf, 2020).[31] Second, decisions to lockdown and implement other restrictive NPIs heavily politicized science, blurring the lines between science and politics and challenging scientific norms and ethical frameworks (Boin and Lodge, 2021; Christensen and Laegreid, 2022; Van Dooren and Noordegraaf, 2020). Research from the sociology of science has shown that 'normal science' was suspended and, in its place, a 'scientific consensus' was manufactured to support mainstream political narratives motivated by urgency, precaution and imperatives for social control (Askim and Christensen, 2022; Berger, 2022; Cairney, 2021; Rangel et al. 2022). This privileged certain scientific *interpretations*, represented in simplistic slogans, models and images (e.g. 'following the science'), most of which promoted a maximalist approach to NPIs and downplayed concerns about their social harms (Hodges et al. 2022; Pykett et al. 2022). Ethical analyses suggest that many policies would be considered unacceptable according to pre-pandemic public health ethical principles (Jamrozik, 2022),[32] although it is unclear exactly how the crisis has re-shaped ethical decision-making frameworks.[33]

Third, some studies on science networks show that experts who opposed government policy and the mainstream consensus were marginalized and denigrated, including in government-led censorship campaigns (Gesser-Edelsburg et al. 2021; Ioannidis 2022; Shir-Raz et al. 2022). This narrowed the range of acceptable scientific opinion for much of 2020-21 and obscured legitimate expert disagreements about alternative policy options and levels of uncertainty, evidence and policy trade-offs (Askim and Christensen, 2022; Caceres, 2022; Mormina, 2022). The unfavourable framing of the Swedish pandemic

[31] This included, for example: Anthony Fauci in the US, Christian Drosten in Germany, Jerome Salomon in France and Jaap van Dissel in the Netherlands (van Dorren and Noordegraf, 2020).
[32] This includes: proportionality, transparency, the need for evidence, the least restrictive alternative, equity, reciprocity, and due legal process (see Jamrozik, 2022).
[33] For example, despite mask mandates having been widely implemented around the world, a recent meta-analysis showed that the evidence for community mask mandates is weak and few RCTs have been conducted (Jefferson et al. 2023). The evidence-base for the effectiveness of lockdown and many other NPIs are similarly disputed as are the various risk communication strategies used by government to influence and shape public perceptions and behaviours, including fear-based and nudge techniques.

approach in English-language Western media is a good example of this polarization. Fourth, the crisis drove a massive increase in Covid-specific scientific publications and research. There are concerns about research quality and the normalization of 'fast science' on overall scientific integrity (Bramstedt, 2020; Khatter et al. 2021; Vickery et al. 2022) and the dominance of Covid in the broader scientific research ecosystem (Ioannidis et al. 2022).

Overall, it is unclear what effect these dynamics have had on viewpoint diversity in higher education, science-based policymaking and the public understanding of science.

Discussion

There are many lessons that can be drawn from this analysis. Five key issues are worth briefly discussing here.

1. Harms are known, far-reaching and alarming

The promotion of lengthy social distancing restrictions by governments and scientific experts during the Covid crisis had severe consequences for hundreds of millions of people. Many original predictions are broadly supported by the cumulative research data presented above: a rise in non-Covid excess mortality, mental health deterioration, child abuse and domestic violence, widening global inequality, large increases in debt, food insecurity, lost educational opportunities, unhealthy lifestyle behaviours, increased loneliness and social polarization, democratic backsliding and human rights violations. These harms are multifaceted. Some are short-term and more decernable, while others are harder to apprehend and will shape individual and collective lives and livelihoods for many years ahead. Research on the social determinants of health has shown how adverse changes in life opportunities, especially in younger ages, shape future health outcomes and socio-economic well-being during an individual's lifespan. Lost human capital are hard to recover, and can create downward spirals of lost opportunity. The pandemic response leaves behind a legacy of poverty, mental health illness, learning loss, debt, food insecurity, social polarization, erosion of respect for human rights and elevated

excess mortality for non-Covid health conditions. These consequences are unequally distributed: the younger generation, individuals and countries with lower socioeconomic status, women and those with pre-existing vulnerabilities were hit hardest and will bear the brunt of future consequences.

2. Important knowledge gaps need to be filled

Academic knowledge about this harm is contigent on the availability and quality of research studies and the range of expert debate and agreement.[34] This analysis has highlighted large gaps in the existing research data and differences between scientific fields and countries. For many issues, there is a noticeable lack of data from low- and middle-income countries. Some areas of research, e.g. mental health and lifestyle changes, have a disproportionate number of meta-analyses and systematic reviews while other areas lack them altogether. This is partially due to the fact that some social effects are simplier to measure and understand in comparison to others, especially over time (e.g. obesity is easier to measure compared to democracy). However it also reflects the lack of longitudinal cohort studies in many countries for important social issues such as household income, social relationships and political attitudes. In addition, very few systematic reviews of qualitative and ethnographic studies were found, which provide a vital source of knowledge to deepen and triangulate quantitative social changes. In particular, it was surprising to find a lack of comprehensive evidence syntheses for the following areas: non-Covid excess mortality, business failures, unemployment and household income, food insecurity, childhood malnutrition, intimate relationships, trust and democratic backsliding. Future systematic reviews should be conducted on these topics.

There are also incongruities between studies, expert disagreements and polarized debates in some fields, which were discussed to some degree in the analysis above. For example, systematic reviews of systematic reviews were available for mental health, domestic violence and child abuse, and highlighted the wide range of variation in research design, methodologies, findings and gaps in current knowledge. Social distancing itself shaped

[34] Other forms of knowledge, such as artistic and creative expression, personal experience and work from the humanities are also important sources of knowledge that should not be discarded.

data quality by disrupting the ability for in-person research. This precipitated a high dependence on online surveys and observational and cross-sectional studies with high-risk of bias. Large variation in study designs and period of data collection was also a problem noted in many reviews, and this influenced selection bias and levels of confidence in data analysis. As discussed in the methods section, and when possible in the analysis above, there is also a need to account for how societal harms were influenced by existing trends in place prior to the pandemic and other confounding factors, and how different levels of resilience mediated their impacts. Further work should engage with the methodological issues of the data presented in this paper.

There were temporal limitations to the available research. The data on changes during the initial few months of the crisis, e.g. the first lockdown, were much more numerous than other periods. Limited research followed changes through time in the same cohort or using representative samples. Another challenge relates to the sheer volume of new research being published on the pandemic. For this reason, publications from 2022 and 2023 were prioritized during the analysis. Further important analyses will be available after the publication of this paper, and a future update may be warranted.

Further work is required to monitor and follow changes through time in the recovery phase that can be traced back to the pandemic response and specific policies. This includes longer-term effects on mental health, chronic diseases, household income, government debt and austerity, financial markets, poverty and food insecurity, educational outcomes, child development, obesity and screen use, among many others. A challenge for this type of reseach will be the ability to account for feedback loops and non-pandemic related systemic vulnerabilities (e.g. to pick one example: the effect of the Russian-Ukrainian war on global food insecurity).

The sheer range of harms that occurred across different spatial, temporal and social scales are at times difficult to integrate and appreciate in general terms. Attempting to evaluate the ‘global’ impact of the Covid pandemic response comes with inherent epistemological challenges, and many important nuances and interpretative judgements could not be

adequately discussed in this analysis. Although the analysis attempted to outline as many societal impacts as possible, it is likely some were missed or not given the full attention they deserved. Individual country-level and comparative studies that engage with the complexity of these impacts, in their unique socio-cultural context, are important to advancing theoretical and practical debates. For this reason, future research should use this report and societal harm framework to systematically review research evidence at a country level, preferably comparing a select number of countries. This would help provide more granularity and nuance, and could also be useful to inform national pandemic evaluations, social policy, capacity building efforts to support better academic research and planning for future health emergencies.

3. Harms should challenge our mental model of the pandemic

The Covid pandemic response created a distinct set of policy narratives that shaped public opinion and human behavour in ways that justified the use of very disruptive non-pharmaceutical interventions by governments. These policies were unprecedented in their scope, duration and consequence. The research data presented above questions foundational aspects of these original narratives, and has significant implications for the historical memory and interpretation of the crisis, as well as efforts to prepare for the next global crisis. Certain public and scientific narratives have grown-up around the pandemic, but many of these do not adequately engage with the myriad of harms created by the Covid response itself. There are two important lessons from the harm research in this regard.

First, the pandemic was not only a Covid health emergency but should rather be interpreted as a *whole-of-society crisis* that required a much broader set of policy expertise and public engagement beyond biomedicine. The pandemic response was based on assumptions that frequently ignored social conditions and inequalities. From a global perspective, and based on this analysis, older individuals from wealthy countries benefited the most from mandatory NPIs while younger individuals from poorer countries were most harmed. Many of the larger systemic risks and vulnerabilities that were created or exacerbated will remain for many years, shaping the individual lifespans

of hundreds of millions of people and broader sociocultural, economic and political realities.

Societal harms occurred in the *name* of public health, and were promoted through a 'global' policy domino effect. Pandemic policies were based on fundamental contradictions: isolate yourself to stay healthy. As discussed above, not all people are safe at home, nor are most able to stay home. Social distancing has social consequences. Constant public messaging about death and hospitalization statistics, especially when they are not accompanied by risk stratification, have psychological consequences. The creation of a state of exception for much of 2020-21 and the promotion of a 'new normal' of mandatory social distancing regulations, and social conformity to them, created a set of *unhealthy* social conditions.

Second, the use of lockdown itself and other NPIs went against many pre-Covid pandemic plans and public health consensus. In general, these supported more targeted and less draconian interventions during a respiratory virus pandemic, including promoting voluntary behavior change and protection of the most vulnerable rather than blanket government laws and restrictions. This conventional wisdom emphasized the need to maintain the normal functioning of society, reduce exaggerated levels of fear and panic, communicate uncertainty and risk distribution, minimize scapegoating and moralization and avoid collateral damage. What happened? Why? And how can it be prevented in the future? Many of the harms described above were and should have been anticipated.

Further research should help clarify how pandemic policies were formulated and how the perceived social consensus was manufactured or curated, including through public opinion polls, special interest groups and group psychology.

4. More research on trade-offs is needed

The aim of this analysis was to document the type and magnitude of societal harms from the Covid response based on the existing academic literature. Future research should compare and contrast the real-world benefits of non-pharmaceutical interventions with the findings in this paper. While some efforts have been made in this regard, it is not readily apparent how existing frameworks for cost-benefit assessments (e.g. econometric methods, quality-of-life assessments and sociological analysis) can meaningfully engage with the range of data documented above. Further work is needed in this regard, and should draw more substantially from ethics, political philosophy, anthropology, economics and law. Interdisciplinary dialogue is also critical with epidemiologists, modellers, public health professionals, physicians and virologists.

This analysis lays the groundwork, a *societal harm framework*, for a more rigorous real-world evaluation of the multifacetted costs vs benefits of government policies during the crisis. It is highly likely that many Covid policies caused more harm than benefit, although further research is needed to explore policy trade-offs, especially at a country-level. This is not to say that NPIs had no beneficial effects or that they were not needed or justified. It is essential that public debate move beyond the false dichotomies that have clouded rational discourse and debate. These are the product of tribalistic impulses and epistemic gatekeeping hiding under the guise of scientific thinking. Specific policies may have been more beneficial in some countries and at certain times than in other countries and at different times. There is no one-size-fits-all approach to a global crisis. Additional research on trade-offs may be able to define a range of preventable social harms that could have been mitigated had certain countries pursued less strict or different types of NPIs or certain social protection policies. This would require counter-factual analysis and other methodologies. It should also consider the appropriateness of a *shielding* or *focused protection* strategy that sought to prioritize social distancing measures for high-risk vulnerable groups in order to minimize harms. There is also a need for more research to engage with data on social protection policies from a comparative perspective.

The ignoring of state dictates and civil disobedience (sometimes called *creative compliance*) to strict government mandates likely buffered the effects of socio-economic impoverishment in many communities, as well as a range of other harms. Some forms of non-compliance can be viewed, counter-intuitively, as *health enhancing*, or beneficial. Meta-studies of human behavior during the crisis (especially of qualitative and ethnographic data) are needed to understand actual levels of compliance and coping strategies; research has been over-reliant on online surveys subject to significant biases.

Any trade-off analysis of costs and benefits of NPIs will face substantial challenges deciding the range of metrics to include and excluded, and how to compare interventions with marginal, medium or large benefits with marginal, medium or large societal harms. The temporal, spatial and social scale of the analysis will also be important. There is a spectrum of current expert opinion about the effectiveness of most Covid policies. This includes analysis of school closures, mask mandates, lockdowns and an assortment of other NPIs (e.g. closing businesses, small gatherings bans, track and trace, psychological nudge techniques, bans on worship, etc). Some early models and even empirical analyses that found benefits from specific NPIs were used to promote maximum Covid suppression (e.g. Zero Covid) and prolonged non-pharmaceutical interventions. However, greater availability of data, new analyses and multi-country comparisons continue to be published, some of which question previous assumptions. The benefits of NPIs have likely been over-stated in many early studies. Scientists have generally been in support of NPIs in line with the perceived societal and government consensus. The scientific community must be willing to relinguish strong past assumptions about hypothetical benefits and recognize the excesses of non-pharmaceutical interventions as they were implemented in the real world rather than in idealized models focused exclusively on Covid disease.

Finally, there is a need to review studies that attempt to isolate the impact of government policies from one another and from voluntary behavior change. It is difficult to disentangle one NPI from a range of policy responses, although this can be achieved through country comparisons or unique natural experiments. As noted above, studies that

attempt to distinguish between restrictions and voluntary behavior change must account for the role of government risk communication in shaping behavioral responses and public opinion through feedbackloops. These studies also struggle with empirical data on the actual level of population compliance and behavioural practices, and instead rely on models or assumed levels which may over-state real-world conditions. These types of analyses are relevant both for knowledge about societal harms and the benefits of NPIs. One priority in this regard is to compare and contrast countries that did not pursue stringent Covid policies (e.g. Sweden, Nicaragua, Tanzania, etc) with their neighbours both in terms of Covid epidemiology and the range of societal harms. There is also a need to consider the relationships between NPI policies and Covid vaccine programs.[35]

The various research priorities mentioned above are essential to ongoing efforts to better prepare for future health emergencies, including epidemics and pandemics, and should be integrated into current global and national policy debates.

5. There are many lessons beyond the Covid pandemic

There are numerous lessons from the pandemic response for health and social policy, emergency management and our understanding of human societies more generally. It is not possible to summarize them all here but a few particular issues are worth noting. First, the data on harms should promote a greater awareness about the complexity of large-scale policy experiments in social distancing and government management of social life. This should support a higher level of healthy skepticism about simplistic narratives and technocratic governance that aim for unrealistic goals presented to the public as urgent moral imperatives. There are certainly many lessons about the need for a rejuvenated civil society, academic freedom and a broader range of mechanisms for more diverse expert policy advice in times of social crises. The pandemic also offers us a mirror into contemporary social trends and problems, and there are many opportunities for scholars to use the pandemic as a natural experiment to re-think fundamental assumptions about social life and human nature. There is also a need to rectify the many harms described in this report in the years ahead through deliberate social policy to

[35] The social consequences of Covid vaccine mandates and passports have been outlined in Bardosh et al. (2022).

mitigate the collateral damage, especially in low- and middle-income countries. This will not be easy, but is essential to ensuring a future of human flourishing.

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Probable causal association between Australia's new regime of high all-cause mortality and its COVID-19 vaccine rollout

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Probable causal association between Australia's new regime of high all-cause mortality and its COVID-19 vaccine rollout

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ABSTRACT: All-cause mortality by week in Australia shows that there was no detectable excess mortality 13 months into the declared pandemic, followed by a step-wise increase in mortality in mid-April 2021, synchronous with the rollout of the COVID-19 vaccine prioritizing elderly, disabled and aboriginal residents. The excess mortality in the vaccination period (mid-April 2021 through August 2022; 14 % larger all-cause mortality than in recent pre-vaccination periods of same time duration; 62 million administered vaccine doses) was 31±1 thousand deaths, which is more than twice the deaths registered as from or with COVID-19. In addition, a sharp peak in all-cause mortality (mid-January to mid-February 2022; 2,600 deaths) is synchronous with the rapid rollout of the booster (9.4 million booster doses, same time period), and is not due to a climatic heatwave. We give thirteen numbered arguments as to why we conclude that the excess mortality in Australia is causally associated with the COVID-19 vaccine. The corresponding vaccine injection fatality ratio (vIFR) is approximately 0.05 %, which we compare to estimated vIFR values from the USA Vaccine Adverse Event Reporting System (VAERS) and from all-cause mortality data for India, Southern states of the USA, Michigan (USA) and Ontario (Canada).

Australia experienced a significant and sustained increase in all-cause mortality, starting with its COVID-19 vaccine rollout aimed at high-risk residents in mid-April 2021, whereas it saw no detectable excess all-cause mortality up to that point during 13 months of a pandemic that was declared by the World Health Organization (WHO) on 11 March 2020.

Starting in mid-April 2021, the all-cause mortality per week in Australia shows a sustained increase of >10 %, during which it never returns to its seasonal low value (of approximately 3,000 deaths/week) and attains highs of >4,000 deaths/week in June-

July-August 2022. The step-wise increase in all-cause mortality remains large up to the final date of presently consolidated official government statistics (week-34 of 2022, week ending 28 August 2022) (Australian Bureau of Statistics, 2022a).

Over the measured period of the step-wise increase in all-cause mortality (mid-April 2021 through August 2022; 14 % larger all-cause mortality than in recent pre-vaccination periods of same time duration; 62 million administered vaccine doses) there are 31±1 thousand excess deaths of all causes in Australia, whereas no excess deaths are detected in the prior 13-month period since a pandemic was declared (mid-March 2020 through mid-April 2021).

The excess all-cause mortality following the COVID-19 vaccine rollout (31,000 deaths, mid-April 2021 through August 2022) is more than twice the total number of deaths registered as being from or with COVID-19 (14,014 deaths, 1 January 2020 through 29 August 2022; WHO, consulted 20 December 2022, https://covid19.who.int/region/wpro/country/au).

The above points are corroborated and illustrated in the following figures.

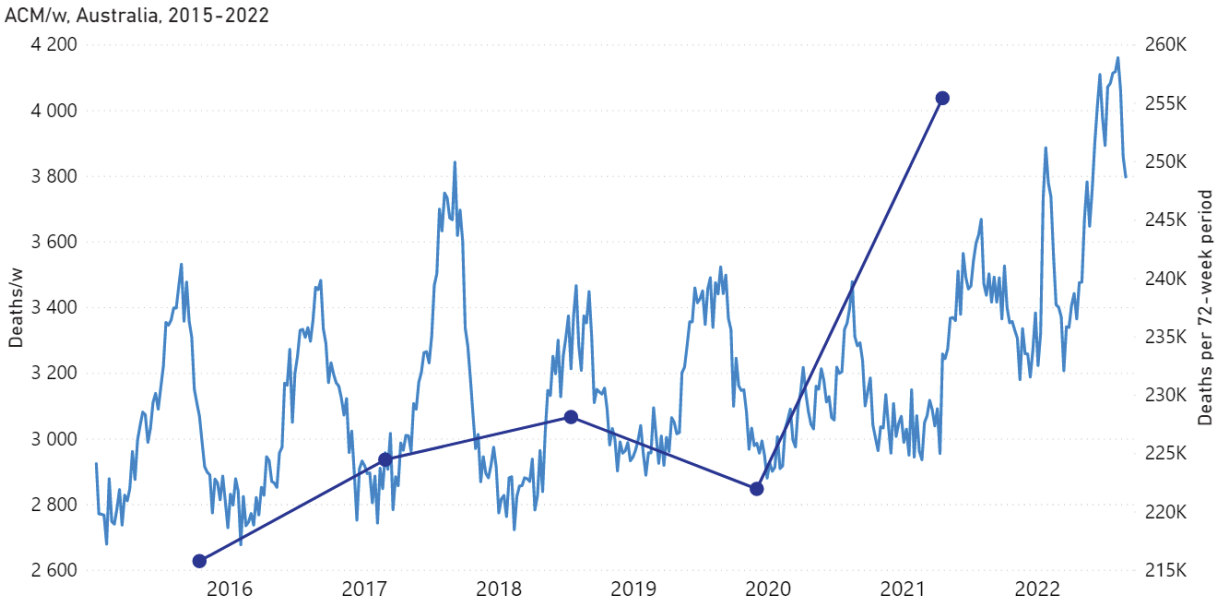

Figure 1A: All-cause mortality in Australia, all ages, from week-1 2015 (week ending 4 January 2015) through week-34 2022 (week ending 28 August 2022). Light-blue: All-cause mortality by week, left y-scale. Dark-blue: Integrated all-cause mortality over successive and non-overlapping 72-week periods (week-15 2021 through week-34 2022, for most recent period), right y-scale. Each point is positioned on the x-axis at the 1st week of its 72-week integration period. (Data source: Australian Bureau of Statistics, 2022a.)

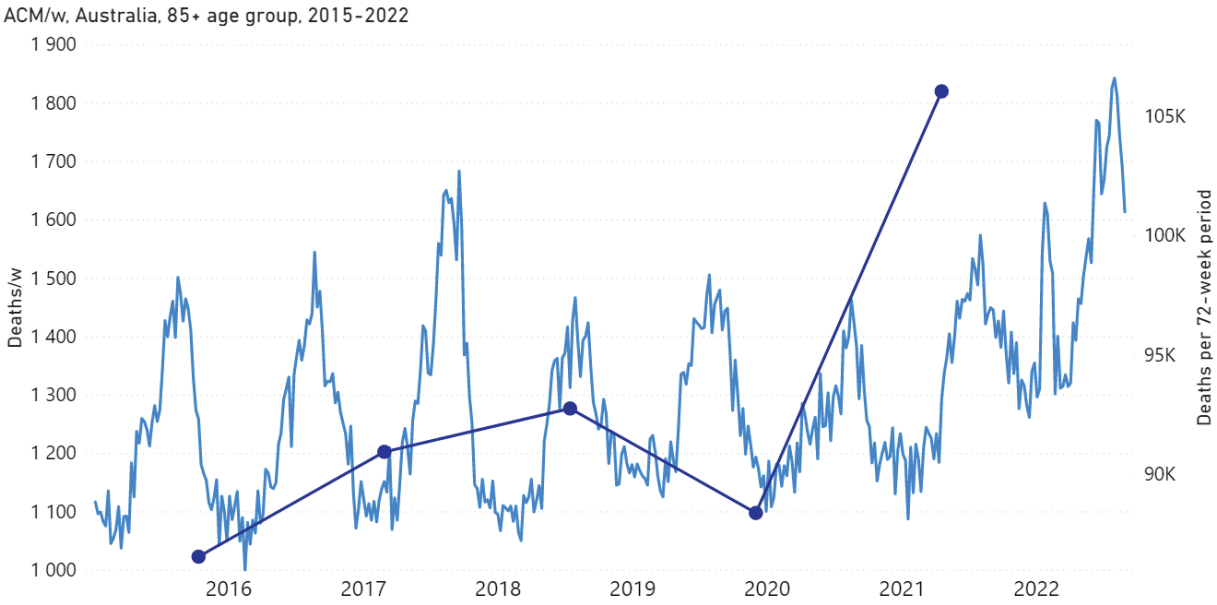

Figure 1B: All-cause mortality in Australia, ages 85+ years, from week-1 2015 (week ending 4 January 2015) through week-34 2022 (week ending 28 August 2022). Light-blue: All-cause mortality by week, left y-scale. Dark-blue: Integrated all-cause mortality over successive and non-overlapping 72-week periods (week-15 2021 through week-34 2022, for most recent period), right y-scale. Each point is positioned on the x-axis at the 1st week of its 72-week integration period. (Data source: Australian Bureau of Statistics, 2022a.)

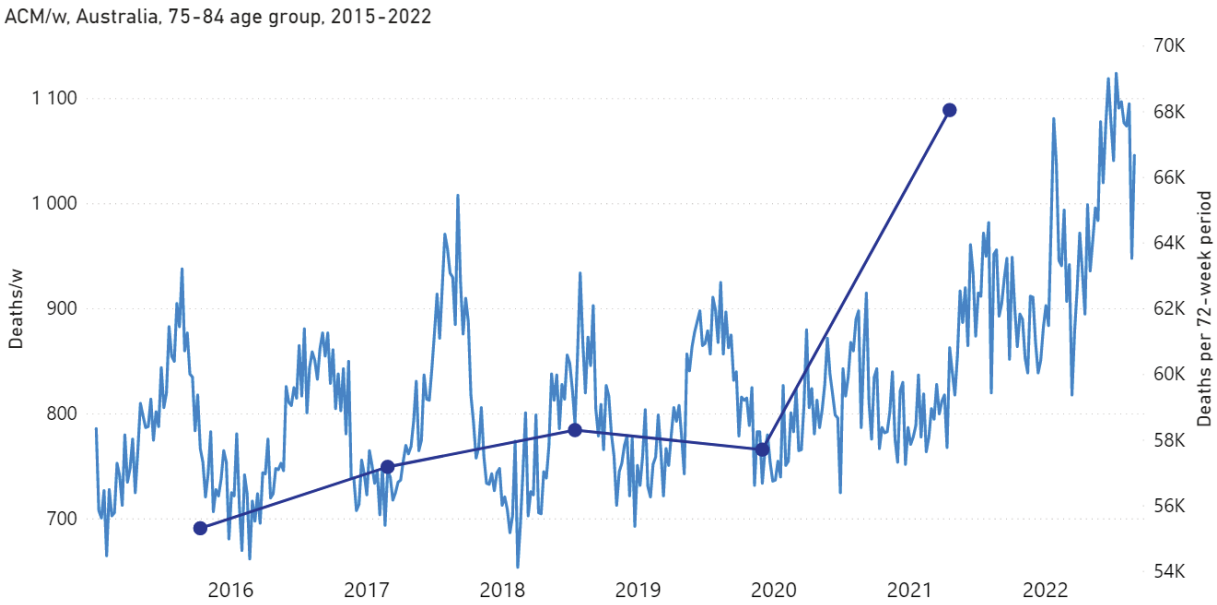

Figure 1C: All-cause mortality in Australia, ages 75-84 years, from week-1 2015 (week ending 4 January 2015) through week-34 2022 (week ending 28 August 2022). Light-blue: All-cause mortality by week, left y-scale. Dark-blue: Integrated all-cause mortality over successive and non-overlapping 72-week periods (week-15 2021 through week-34 2022, for most recent period), right y-scale. Each point is positioned on the x-axis at the 1st week of its 72-week integration period. (Data source: Australian Bureau of Statistics, 2022a.)

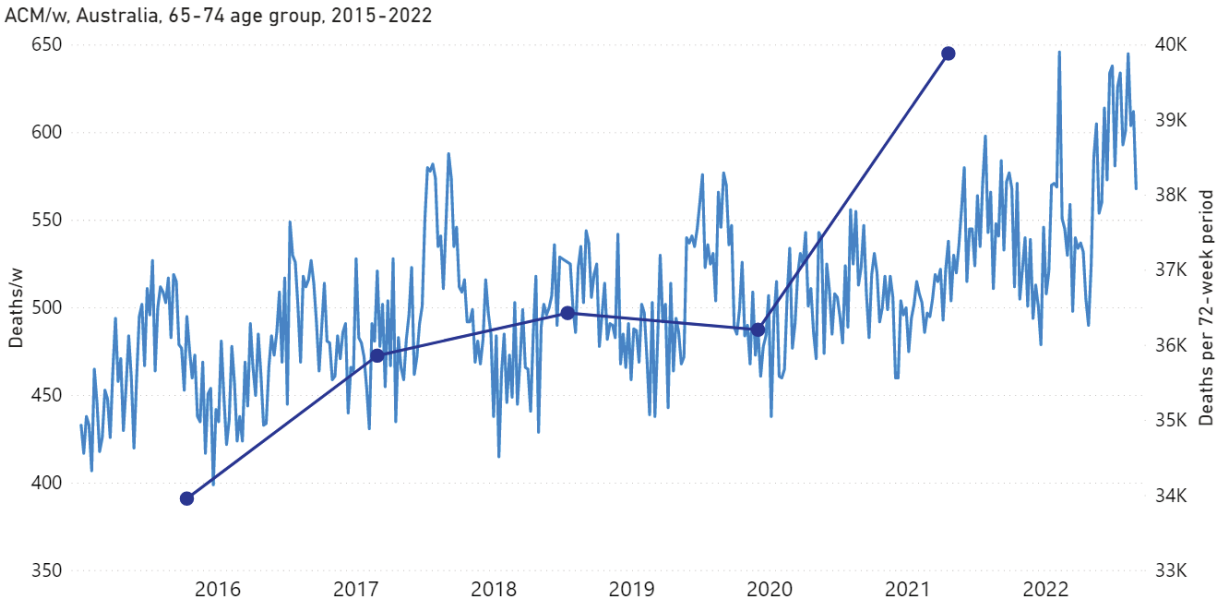

Figure 1D: All-cause mortality in Australia, ages 65-74 years, from week-1 2015 (week ending 4 January 2015) through week-34 2022 (week ending 28 August 2022). Light-blue: All-cause mortality by week, left y-scale. Dark-blue: Integrated all-cause mortality over successive and non-overlapping 72-week periods (week-15 2021 through week-34 2022, for most recent period), right y-scale. Each point is positioned on the x-axis at the 1st week of its 72-week integration period. (Data source: Australian Bureau of Statistics, 2022a.)

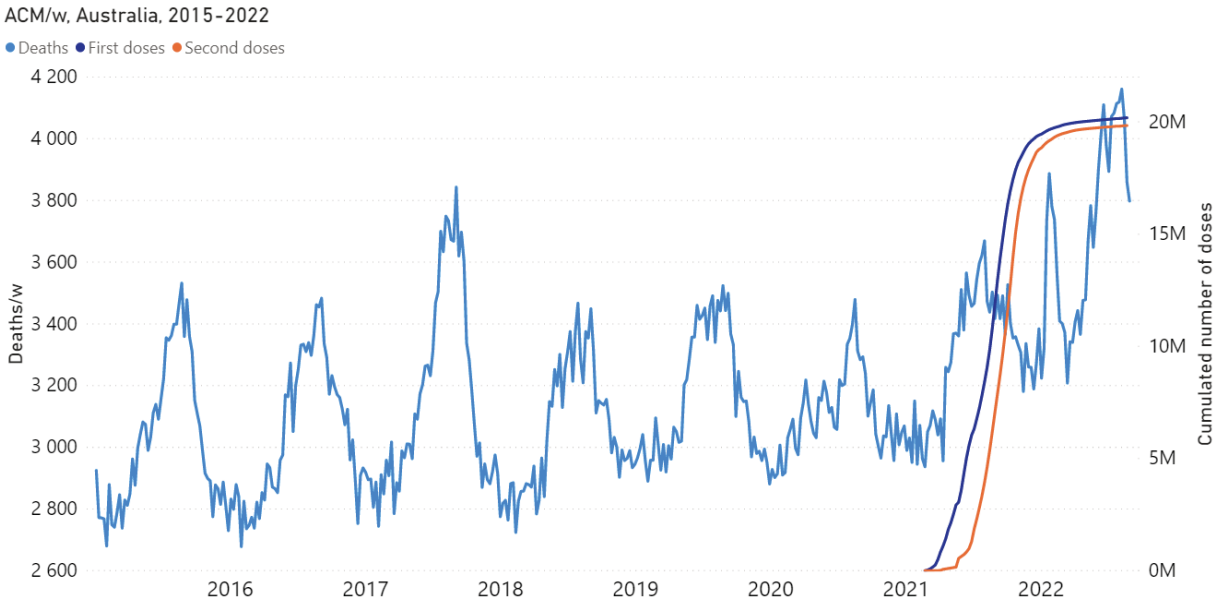

Figure 2: All-cause mortality in Australia, all ages, from week-1 2015 (week ending 4 January 2015) through week-34 2022 (week ending 28 August 2022), compared to the COVID-19 vaccine rollout. Light-blue: All-cause mortality by week, left y-scale. Dark-blue: Cumulative 1st doses of the vaccine. Orange: Cumulative 2nd doses of the vaccine. (Data sources: Australian Bureau of Statistics (2022a); and https://www.covid19data.com.au/vaccines, consulted on 14 December 2022.)

The vaccine rollout is shown in more detail as follows.

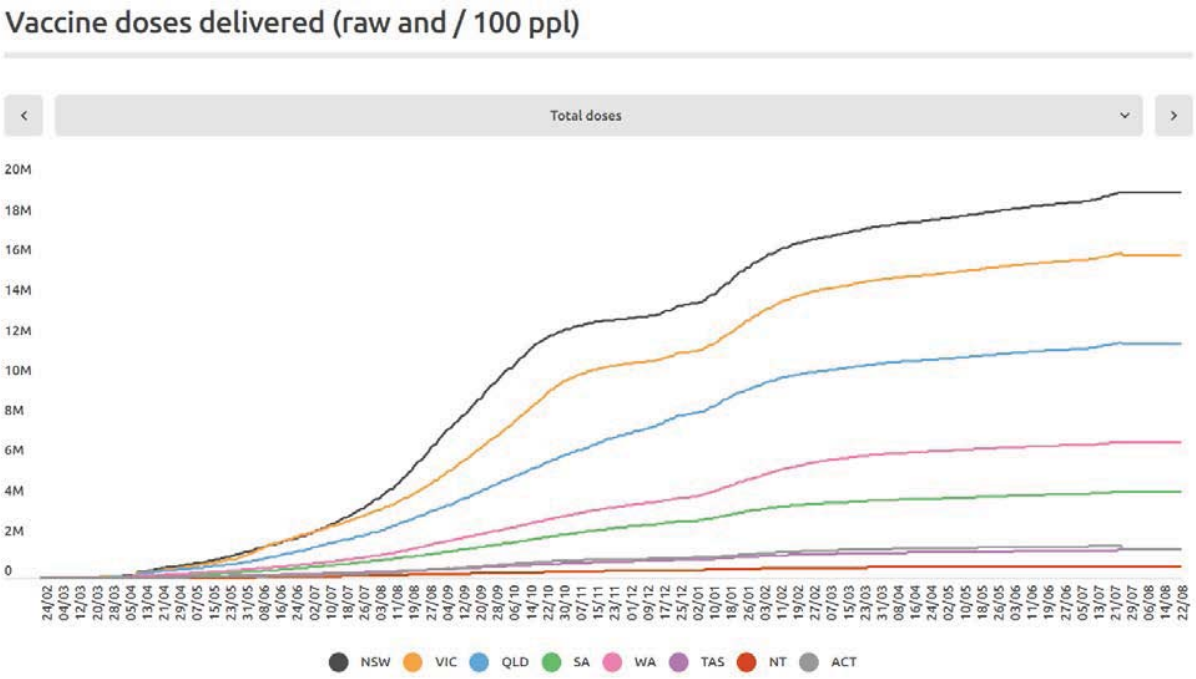

Figure 3A: Cumulative COVID-19 vaccine doses administered (all dose types) by time (24 February 2021 through 22 August 2022) by state in Australia (as indicated, in the sequence NSW, VIC, QLD, SA, WA, TAS, NT, ACT). (Source: https://www.covid19data.com.au/vaccines, accessed 20 December 2022.)

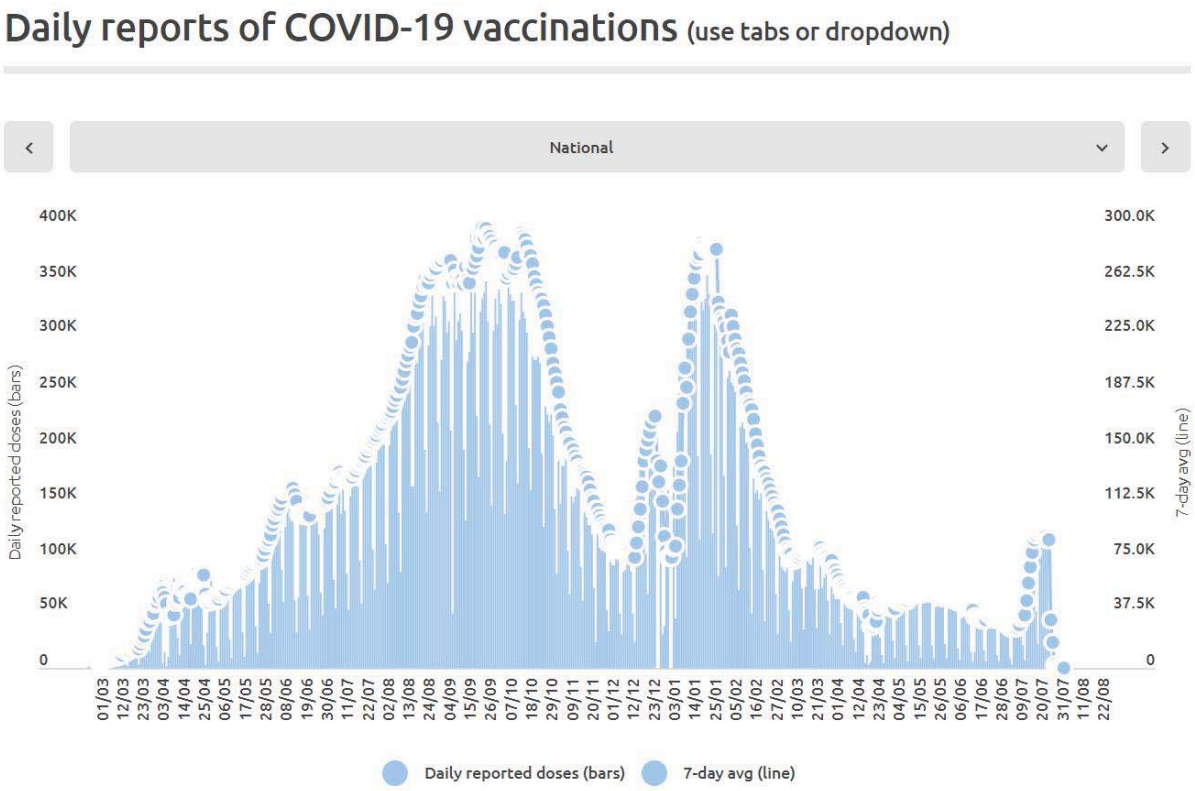

Figure 3B: Daily and 7-day average daily reported COVID-19 vaccine doses (all dose types) administered by time (1 March 2021 through 22 August 2022) in Australia. (Source: https://www.covid19data.com.au/vaccines, accessed 20 December 2022.)

Mortality and vaccination data specifically for the state of Victoria (VIC), Australia, is shown, for example, as follows.

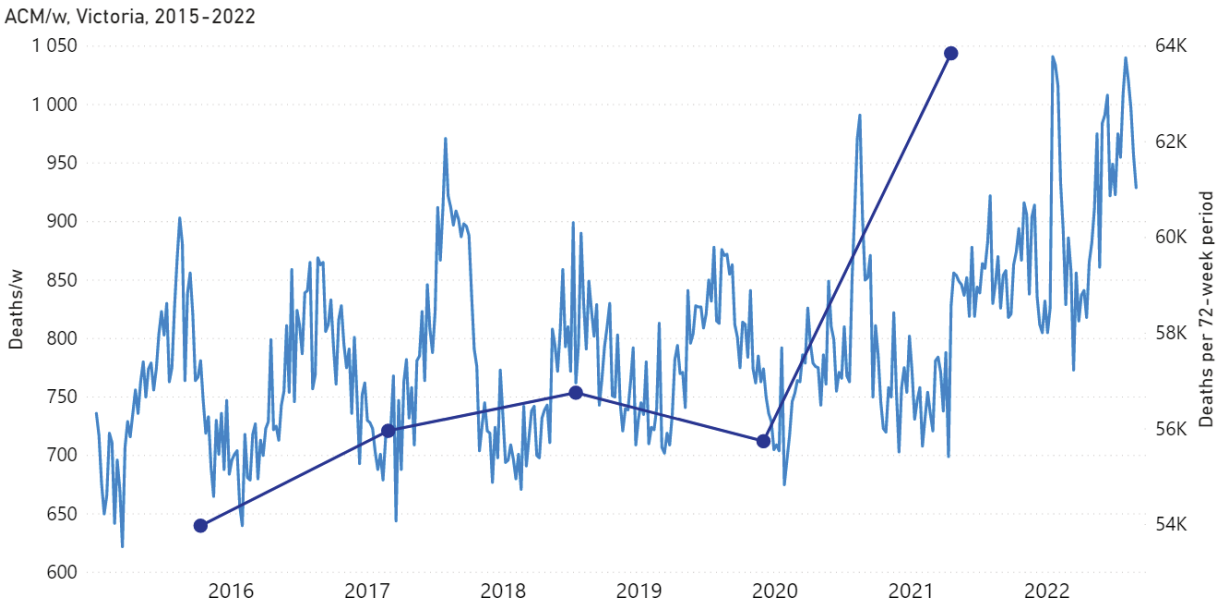

Figure 4A: All-cause mortality in the state of Victoria (VIC), Australia, all ages, from week-1 2015 (week ending 4 January 2015) through week-34 2022 (week ending 28 August 2022). Light-blue: All-cause mortality by week, left y-scale. Dark-blue: Integrated all-cause mortality over successive and non-overlapping 72-week periods (week-15 2021 through week-34 2022, for most recent period), right y-scale. Each point is positioned on the x-axis at the 1st week of its 72-week integration period. (Data source: Australian Bureau of Statistics, 2022a.)

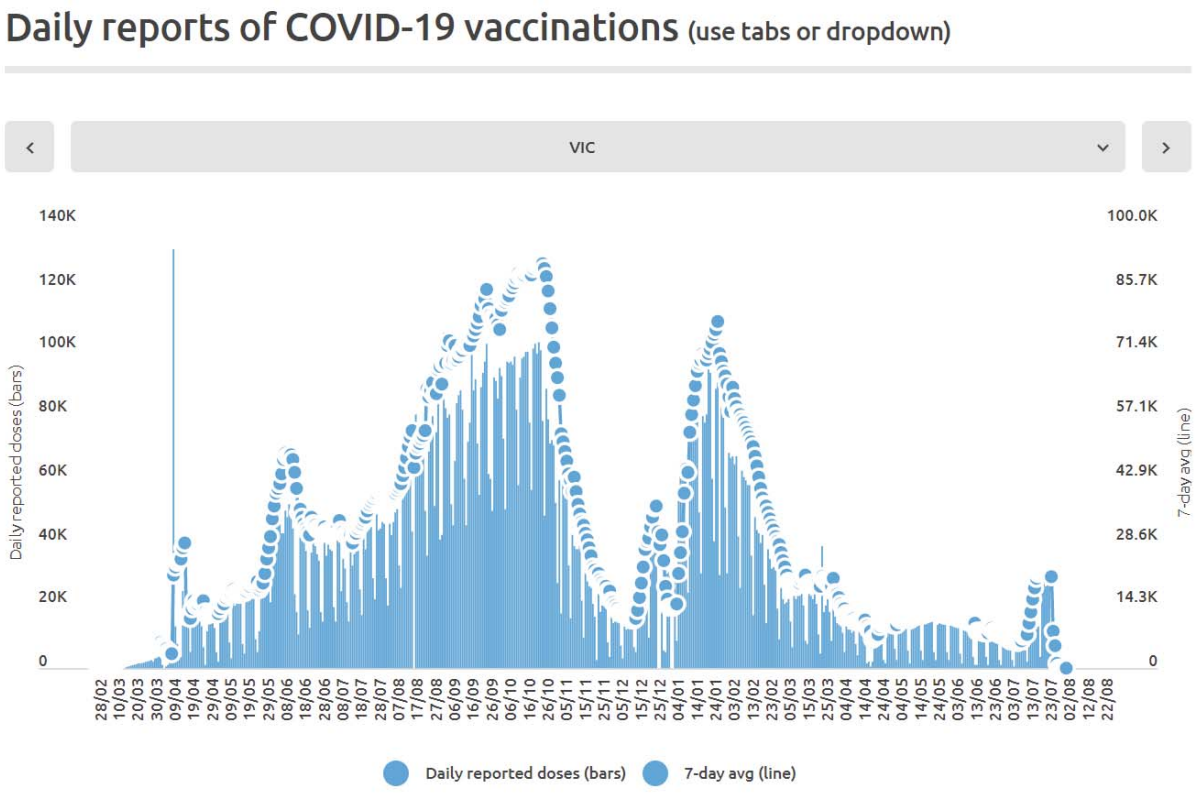

Figure 4B: Daily and 7-day average daily reported COVID-19 vaccine doses (all dose types) administered by time (28 February 2021 through 22 August 2022) in the state of Victoria (VIC), Australia. (Source: https://www.covid19data.com.au/vaccines, accessed 20 December 2022.)

The step-wise increase in mortality is evident in Figure 1 (A through C), and it is synchronous with the COVID-19 vaccine rollout (Figures 2, 3 and 4).

The step-wise transition to a regime of larger all-cause mortality is also seen in the different states of Australia. The example of Victoria is shown in Figure 4. The same phenomenon occurs in the all-cause mortality of all the eight states of Australia, although not clearly in NT (Northern Territory) (Appendix 1).

In addition to the above-described step-wise change in regime of all-cause mortality, there is a prominent peak in all-cause mortality, having a full duration of seven weeks, from mid-January to mid-February 2022. It is not consistent with a seasonal feature and it is synchronous with a large burst in COVID-19 vaccine dose delivery (Figures 1, 3B

and 4), which was the rollout of the booster (3rd doses) in Australia. The said 7-week-duration peak in all-cause mortality is prominent in the states NSW, QLD and VIC, but is essentially not present in the other states (Appendix 1). The booster rollout is shown in the following Figures 5 and 6.

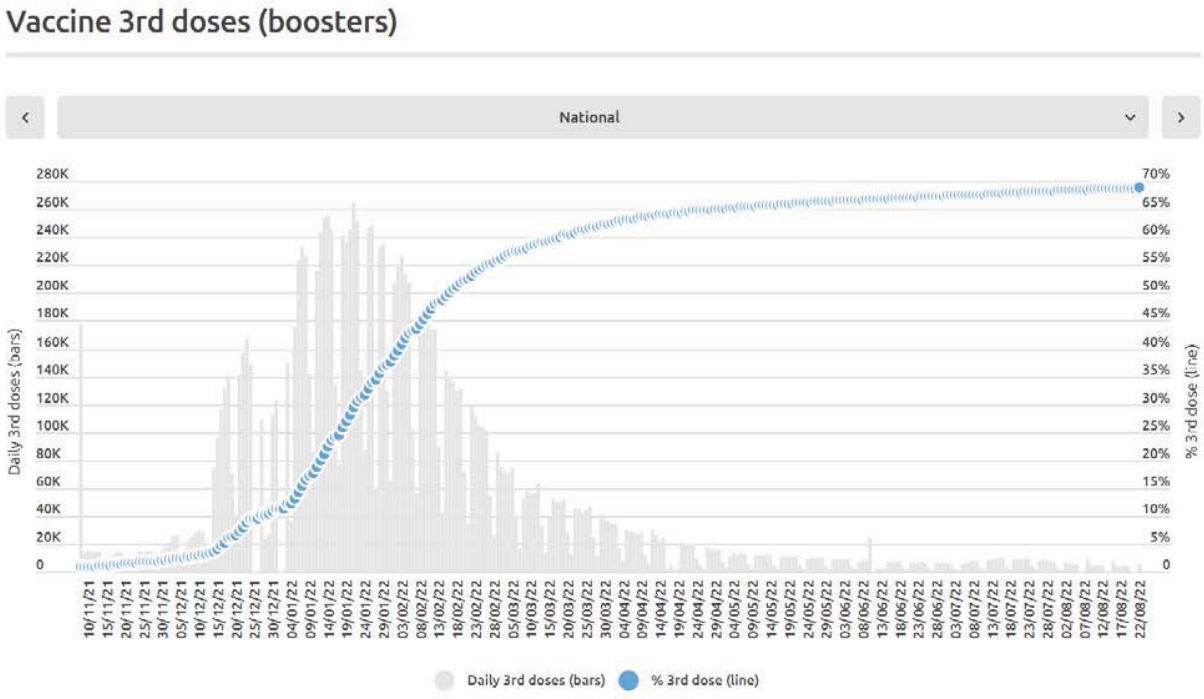

Figure 5: Daily and cumulative booster (3rd doses) rollout in Australia. The time axis is from 10 November 2021 through 22 August 2022. (Source: https://www.covid19data.com.au/vaccines, accessed 20 December 2022.)

Direct comparisons between all-cause mortality by week for the mid-January to mid-February 2022 peak and booster delivery by week are shown below, for Australia and for the states NSW, VIC and QLD (Figures 6A through 6D).

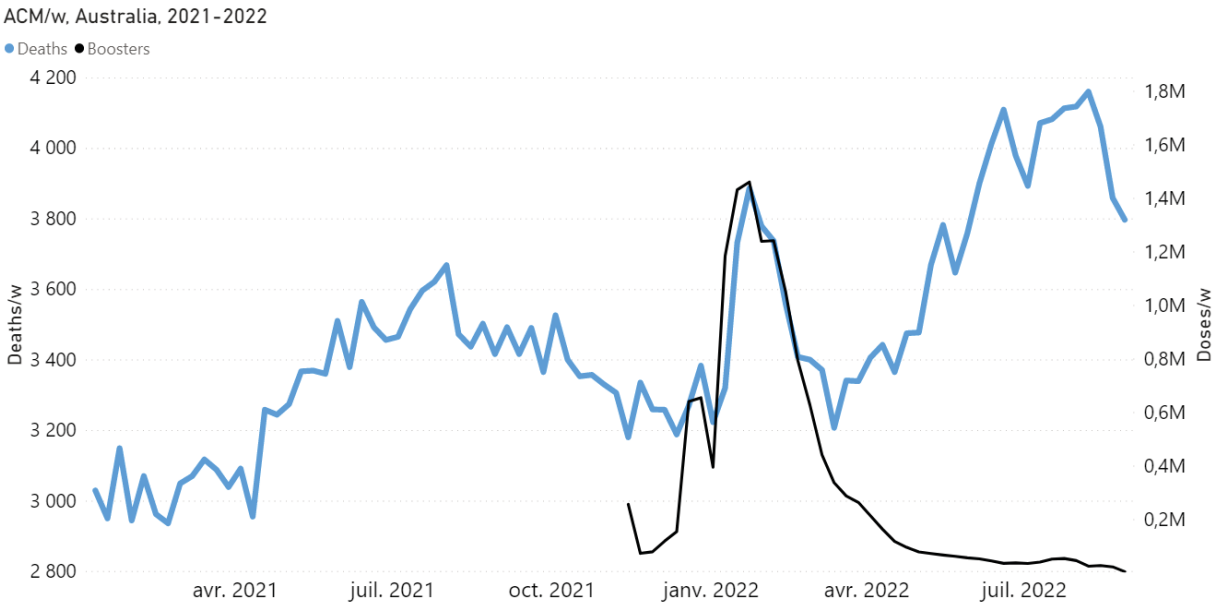

Figure 6A: Highlight of the mid-January to mid-February 2022 mortality peak, in relation to booster (3rd doses) delivery, in Australia. All-cause mortality by week (light-blue) and booster doses delivered by week (black) from 2021 to 2022. (Data sources: Australian Bureau of Statistics (2022a); and https://www.covid19data.com.au/vaccines, consulted on 14 December 2022.)

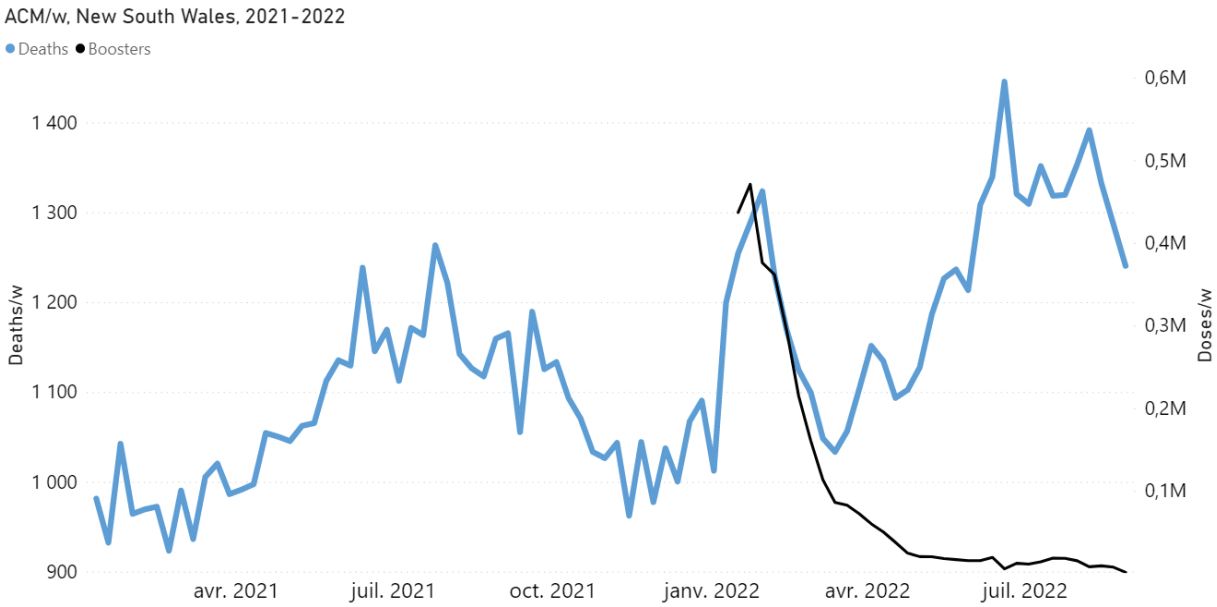

Figure 6B: Highlight of the mid-January to mid-February 2022 mortality peak, in relation to booster (3rd doses) delivery, in NSW (Australia). All-cause mortality by week (light-blue) and booster doses delivered by week (black) from 2021 to 2022. Both mortality and booster delivery are for NSW. (Data sources: Australian Bureau of Statistics (2022a); and https://www.covid19data.com.au/vaccines, consulted on 14 December 2022.)

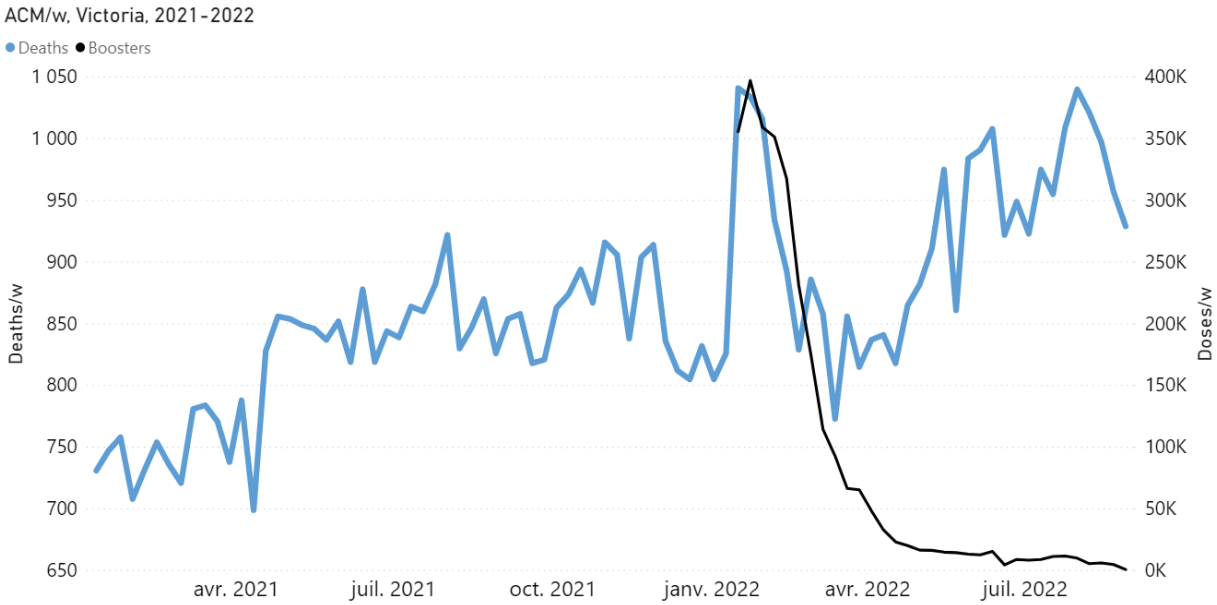

Figure 6C: Highlight of the mid-January to mid-February 2022 mortality peak, in relation to booster (3rd doses) delivery, in VIC (Australia). All-cause mortality by week (light-blue) and booster doses delivered by week (black) from 2021 to 2022. Both mortality and booster delivery are for VIC. (Data sources: Australian Bureau of Statistics (2022a); and https://www.covid19data.com.au/vaccines, consulted on 14 December 2022.)

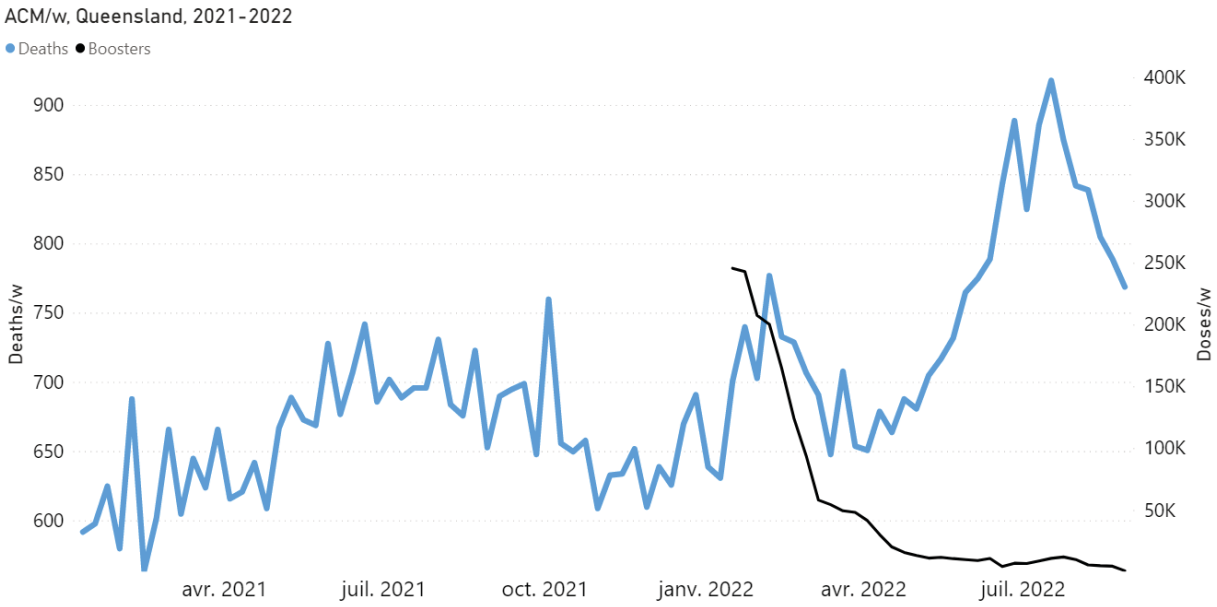

Figure 6D: Highlight of the mid-January to mid-February 2022 mortality peak, in relation to booster (3rd doses) delivery, in QLD (Australia). All-cause mortality by week (light-blue) and booster doses delivered by week (black) from 2021 to 2022. Both mortality and booster delivery are for QLD. (Data sources: Australian Bureau of Statistics (2022a); and https://www.covid19data.com.au/vaccines, consulted on 14 December 2022.)

The integrated excess mortality in the 7-week-duration peak, relative to its baseline, is approximately 2,600 deaths, compared to approximately 9.4 million booster doses delivered over the duration of the mortality peak. This corresponds to a vaccine injection fatality ratio (vIFR) of approximately 0.03 %, which in turn is not too different from the vIFR of 0.008 % for 65+ year old USA subjects injected with the Janssen vaccine, calculated from the Vaccine Adverse Event Reporting System (VAERS) data by Hickey and Rancourt (2022) (their Table 1).

An alternative hypothesis for the 7-week-duration mortality peak would be that it was caused by an Australian summer heatwave affecting Eastern Australia. This hypothesis is not tenable with the climatic and mortality data, which we demonstrate in Appendix 2.

For the following reasons (presented as numbered points), taken together, we conclude that the 16-month (mid-April 2021 through August 2022) sustained regime of large excess all-cause mortality in Australia may largely or predominantly be caused by its vaccine rollout, including the booster (3rd doses).

1 - There is a clear temporal association between the new regime of heightened all-cause mortality and the vaccine rollout, whereas Australia did not have detectable excess mortality up to the start of the rollout, during 13 months of a pandemic that was declared by the WHO on 11 March 2020. (Figures 1, 2, 4 and 6; and Appendix 1)

2 - The excess mortality in the vaccination period (mid-April 2021 through August 2022) for Australia (all ages) is 31,000 (±1,000) deaths (Figure 1A), which is more than twice the total number of deaths registered as being from or with COVID-19 (14,014 deaths, 1 January 2020 through week ending 29 August 2022; WHO, consulted 15 December 2022, https://covid19.who.int/region/wpro/country/au).

Note that the percentage of total COVID-19-assigned deaths that are “with COVID-19” (rather than “from COVID-19”) varies between approximately 10 % and 30 %, in the period January 2022 through August 2022 (Australian Bureau of Statistics, 2022b; their figure entitled “Proportion of deaths from and with COVID-19 during the Omicron wave”, and see “Proportion of deaths from and with COVID-19 during the Omicron wave by state of registration”). Here, death “from COVID-19” means that COVID-19 is assigned as “the underlying cause of death as the disease or condition that initiated the train of morbid events leading to death”, whereas other diseases and conditions reported as contributing to death are “referred to as associated causes” (Australian Bureau of Statistics, 2022c). In fact, 95.4 % of deaths “from COVID-19” in Australian death certificates had non-COVID-19 “causal sequences of events” and/or “pre-existing chronic conditions” (Australian Bureau of Statistics, 2022c; their table entitled “Number of deaths due to COVID-19 that has associated conditions”).

The question is unavoidable: Why would Australians suddenly (at the start of the vaccine rollout) start dying in excess of something mostly if not entirely other than COVID-19, after 13 months of a declared pandemic during which there was no detectable excess all-cause mortality?

3 - The mean vIFR in the vaccination period (mid-April 2021 through August 2022) for Australia, therefore, would be:

$$31 \text{ K deaths} \;/\; 62 \text{ M vaccine doses}^{1} \;=\; 0.05\ \%$$

which is larger than the vIFR of 0.008 % for 65+ year old USA subjects injected with the Janssen vaccine, calculated from the VAERS data (Hickey and Rancourt, 2022; their Table 1), and smaller than the estimated 1 % calculated for the excess mortality event in India (Rancourt, 2022), and for excess mortality peaks for several Southern states of

[1] Cumulative COVID-19 vaccine doses administered: All doses, including boosters, are counted individually; administered 14 April 2021 through 25 August 2022, 63.01M - 1.36M = 62M. Our World in Data, accessed 16 December 2022: https://ourworldindata.org/explorers/coronavirus-data-explorer?facet=none&Interval=Cumulative&Relative+to+Population=false&Color+by+test+positivity=false&country=~AUS&Metric=Vaccine+doses

the USA (Rancourt et al., 2022). As such, the 0.05 % estimated mean vIFR for Australia is within an expected range for real-world circumstances.

4 - In addition to the above-described vaccination-period regime of all-cause mortality (mid-April 2021 through August 2022), there is a prominent peak in all-cause mortality from mid-January to mid-February 2022, having a full duration of seven weeks, which is synchronous with a large burst in COVID-19 vaccine dose delivery (Figures 1, 3B, 4 and 6). The said large burst in vaccine dose delivery was the rollout of the booster (3rd doses) in Australia (Figures 5 and 6).

We stress that Figure 6, showing a high degree of synchronicity (in both position and width) between the mid-January to mid-February 2022 all-cause mortality peak and the booster (3rd doses) delivery pattern, with the booster delivery surge generally leading the mortality surge by approximately 1 week, represents strong evidence for a causal relation; the strongest we have seen in all-cause mortality data.

5 - The said prominent peak in all-cause mortality from mid-January to mid-February 2022 has an integrated excess mortality in its 7-week duration, relative to its baseline, of approximately 2,600 deaths, compared to approximately 9.4 million booster doses delivered over the duration of the mortality peak. This corresponds to a calculated vIFR for the specific mortality peak:

$$2.6 \text{ K deaths} \;/\; 9.4 \text{ M vaccine doses}^{2} \;=\; 0.03\ \%$$

which is comparable in value to that obtained (0.05 %) for the mean vIFR in the vaccination period (mid-April 2021 through August 2022) for Australia.

[2] Estimated using cumulative COVID-19 vaccine doses administered: All doses, including boosters, are counted individually; administered 8 January 2022 through 21 February 2022, 53.4M - 44.0M = 9.4M. Our World in Data, accessed 16 December 2022: https://ourworldindata.org/explorers/coronavirus-data-explorer?facet=none&Interval=Cumulative&Relative+to+Population=false&Color+by+test+positivity=false&country=~AUS&Metric=Vaccine+doses

6 - The impact of the rollout would be sudden, as observed (Figures 1, 2, 4A and 6; and Appendix 1), because Australia prioritized elderly, disabled and aboriginal residents (Australian Government - Department of Health and Aged Care, 2021).

7 - The step-wise increase in all-cause mortality, into the regime of excess all-cause mortality (mid-April 2021 through August 2022) occurs simultaneously in mid-April 2021 across all of Australia, in the eight states (see Appendix 1), rather than showing any distribution of starting times, which would be compatible with a spreading infectious disease seeding different regions at different times and spreading at different rates depending on regional differences of social and health conditions.

In this regard, theoretical models of spreading and emerging pandemics show high sensitivity of dynamic outcomes to seeding, societal population size, and inferred social and health conditions (Parham and Michael, 2011; Hasegawa and Nemoto, 2016; Ma et al., 2022).

8 - The VAERS data of the USA unambiguously shows excess all-cause deaths immediately following injections with each of the three types of COVID-19 vaccines used in the USA, with a prominent peak within 5 days of injection and an exponentially decaying excess mortality extending 2 months following injection (Hickey and Rancourt, 2022; see their Figs. S3 through S5). The integrated mortality by number of injections following injection (injection toxicity or vIFR) increases exponentially with age, as does the batch to batch variability of toxic effect (Hickey and Rancourt, 2022; see their Fig. S6). The latter observations of exponential increases with age mean that the injections represent fatal challenges in proportion to frailty of the subject.

9 - Detailed histopathological and immunohistochemical autopsy studies have demonstrated that the COVID-19 vaccines are causes of death, both in otherwise healthy subjects and in elderly subjects with comorbidities (Choi et al., 2021; Schneider et al., 2021; Sessa et al., 2021; Gill et al., 2022; Mörz, 2022; Schwab et al., 2022; Yoshimura et al., 2022).

10 - The Australian Government interprets both test results (cases) and the mortality as occurring in four “waves”, which it describes by time period as follows (Australian Bureau of Statistics, 2022b):

- “Wave 1: as occurring between March and May 2020. The predominant variant during Wave 1 was the original virus strain.
- Wave 2: as occurring between June and November 2020. Wave 2 predominantly occurred in Victoria. The variant during Wave 2 was the original virus strain.
- Delta wave: as occurring between July and December 2021.
- Omicron wave: as occurring during 2022 (until the end of September 2022). Due to the length of this wave and the higher number of deaths […].”

We have not found any study establishing a scientific basis for the Australian Government’s assignation of these waves. Furthermore, the said Government’s assignation is irreconcilable with:

i. the absence of detected excess mortality in March-May 2020 (Figure 1; and Appendix 1),
ii. the absence of detected excess mortality in Australia (Figure 1A) and in Victoria (Figure 4A) in the period June-November 2020 (and see Appendix 1),
iii. a Delta-variant wave (July-December 2021) that would have missed both the mid-April 2021 step-wise surge in excess all-cause mortality and the 7-week-duration mid-January to mid-February 2022 peak in excess all-cause mortality, and
iv. an Omicron-variant wave (2022) that would have caused two distinct and prominent features in excess all-cause mortality, namely the mid-January to mid-February 2022 7-week-duration peak and the large surge that followed starting in May 2022 (Figure 1A).

The official interpretive situation is similar, although less sophisticated, to that employed by Dhar et al. (2021) who postulated that the April-July 2021 “second wave” event in Delhi (the capital city of India) was due to the Delta variant, which would have quickly

swept Delhi to become predominant because it would have higher transmissibility and larger immune escape than concomitantly circulating variants. However, Dhar et al. estimate the needed characteristics of Delta by fitting a model to the epidemiological data and to the variant predominance estimated by genomic measurements from small non-randomized cohorts. Leaving aside the large known and unknown uncertainties throughout their exercise, basically, the inferred characteristics of Delta are obtained by fitting to the data, rather than being independently measured in a controlled clinical trial. Under such circumstances, the mortality event creates an illusion of the needed Delta for Delhi, but an actual Delta cannot be concluded to have caused the mortality event.

Likewise, the Australian Government's assignation of COVID-19 waves for Australia is merely a naming exercise of reported test results (case statistics), coupled to sparse and unreliable genomic measurements (Australian Government - Department of Health and Aged Care, 2022). The Australian Government's assignation is contradicted by hard data of all-cause mortality by time.

11 - A similar synchronicity between vaccine dose delivery and excess all-cause mortality is observed in connection with the so-called "vaccine equity" campaigns in the USA. An anomalous fall-2021 peak was interpreted as being caused by the vaccines, and is prominent in the 25-64 years age group in 21 states of the USA, most notably including Alabama, Mississippi, Georgia, Florida and Louisiana (Rancourt et al., 2022). The data for Mississippi is shown below (Figure 7).

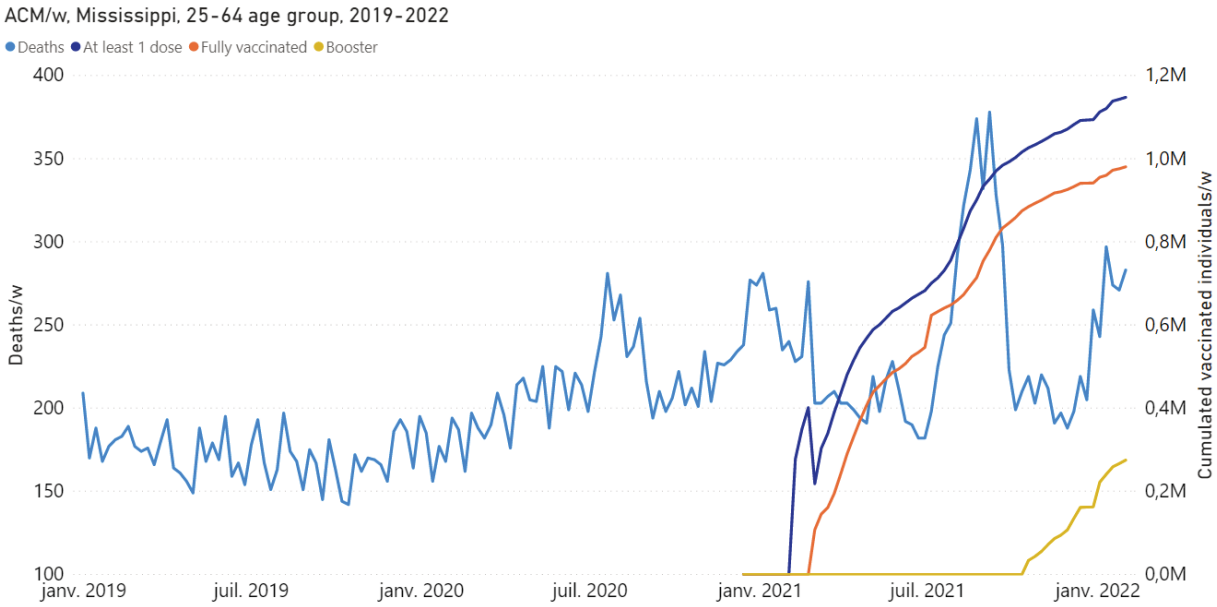

Figure 7: Rancourt et al. (2022), their Fig. 11B. All-cause mortality by week (light-blue), cumulated number of people with at least one dose of vaccine (dark-blue), cumulated number of fully vaccinated people (orange) and cumulated number of people with a booster dose (yellow) by week from 2019 to 2022, for 25-64 years age group in Mississippi. Data are displayed from week-1 of 2019 to week-5 of 2022.

In the study by Rancourt et al. (2022), it was concluded that significant (detectable by all-cause mortality) vaccine-induced mortality occurred primarily among fragile groups, characterized by high degrees of poverty, disability, obesity, diabetes, and high medication rates. The vaccine injection was seen as an additional challenge, often accelerating and causing death in residents with comorbidities.

12 - Another example of probably causal synchronicity between a rapid COVID-19 vaccine rollout prioritizing elderly, frail and disabled residents and large excess all-cause mortality is that of India (Rancourt, 2022). In that case, the early rollout of the vaccine in April-July 2021 was devastating, causing the deaths of approximately 3.7 million residents, on administering approximately 350 million doses of the vaccine (in a population of 1.39 billion). This corresponds to an effective vIFR (per-dose toxicity) of approximately 1 %. It is also approximately the same vIFR (1 %) as is consistent with the anomalous fall-2021 peak in excess all-cause mortality occurring in high-poverty

states of the USA, which was interpreted as being caused by the vaccine (Rancourt et al., 2022; and see the data for Mississippi shown in Figure 7).

Clearly, frail residents are susceptible to being fatally harmed by the injection and should be protected against state-run injection campaigns implemented without stringent individual clinical risk assessment. It appears that the population-wide COVID-19 vIFR can be as large as 1 % (India, Southern USA states), and is approximately 0.05 % in Australia.

Both India and Australia had virtually no detectable excess all-cause mortality after a pandemic was declared by the WHO, until their respective COVID-19 vaccine rollouts, which makes the synchronicity association relatively easy to assign.

13 - Two more examples of synchronicity between a rapid COVID-19 vaccine rollout prioritizing elderly and vulnerable residents and large excess all-cause mortality occur for Michigan, USA (Rancourt et al., 2022) and Ontario, Canada.

Key figures for Michigan, USA are as follows (Figure 8). The COVID-19 vIFR in the main rollout of the vaccine in Michigan is comparable in value to that for the vaccination period for Australia (0.05 %).

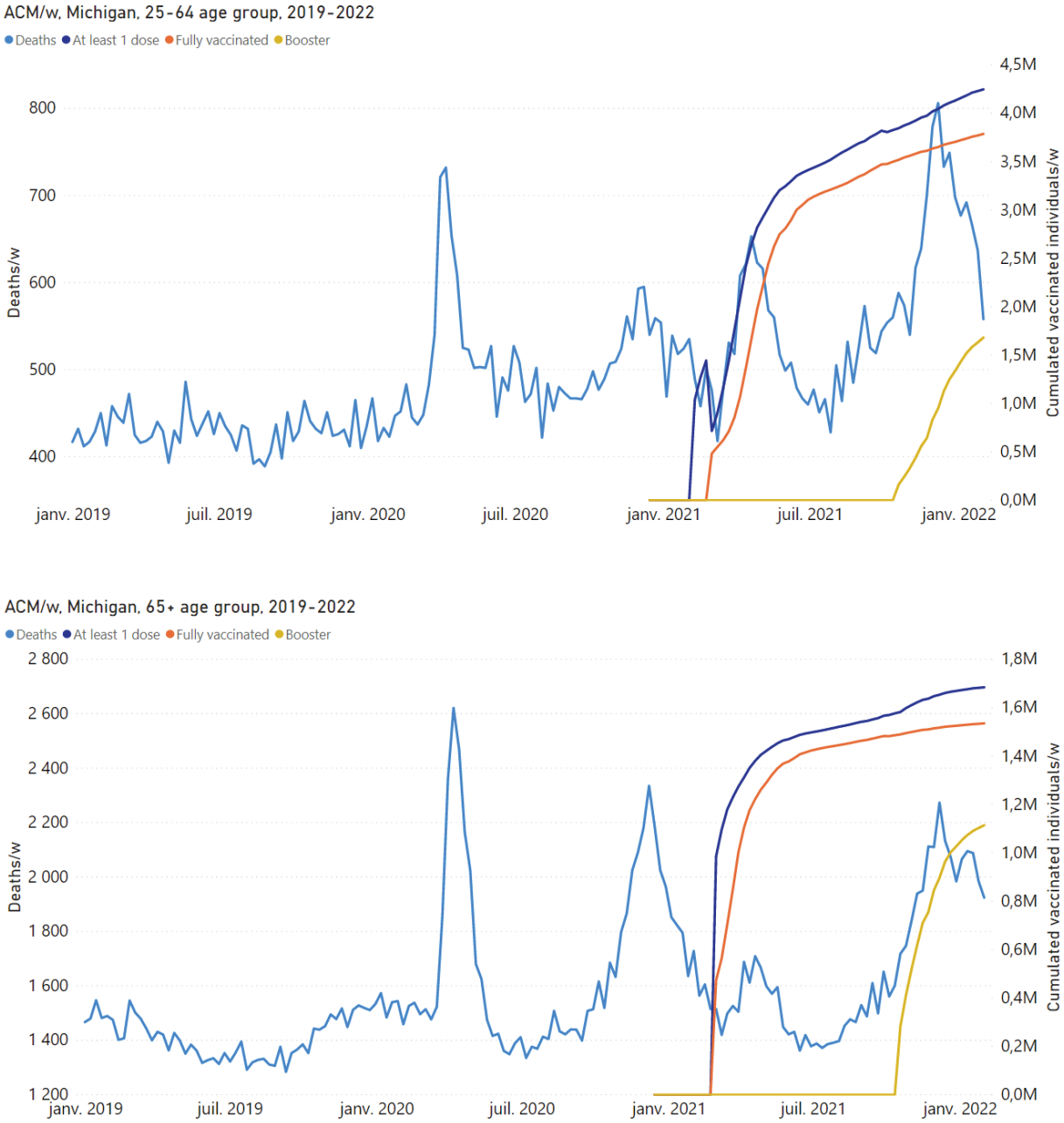

Figure 8: All-cause mortality by week (light-blue), cumulative number of people with at least one dose of vaccine (dark-blue), cumulative number of fully vaccinated people (orange) and cumulative number of people with a booster dose (yellow) by week from 2019 to 2022, and by age group for Michigan, USA. Data are displayed from week-1 of 2019 to week-5 of 2022. Upper panel: (Rancourt et al., 2022; their Figure 11G) Michigan, 25-64 years age group. For the 25-64 years age group, the vaccination data is for the 18-64 years age group. Lower panel: (Rancourt et al., 2022; their Figure 11H) Michigan, 65+ years age group. The discontinuous breaks in cumulative number of vaccinated individuals are artifacts.

A key figure for Ontario, Canada is as follows (Figure 9).

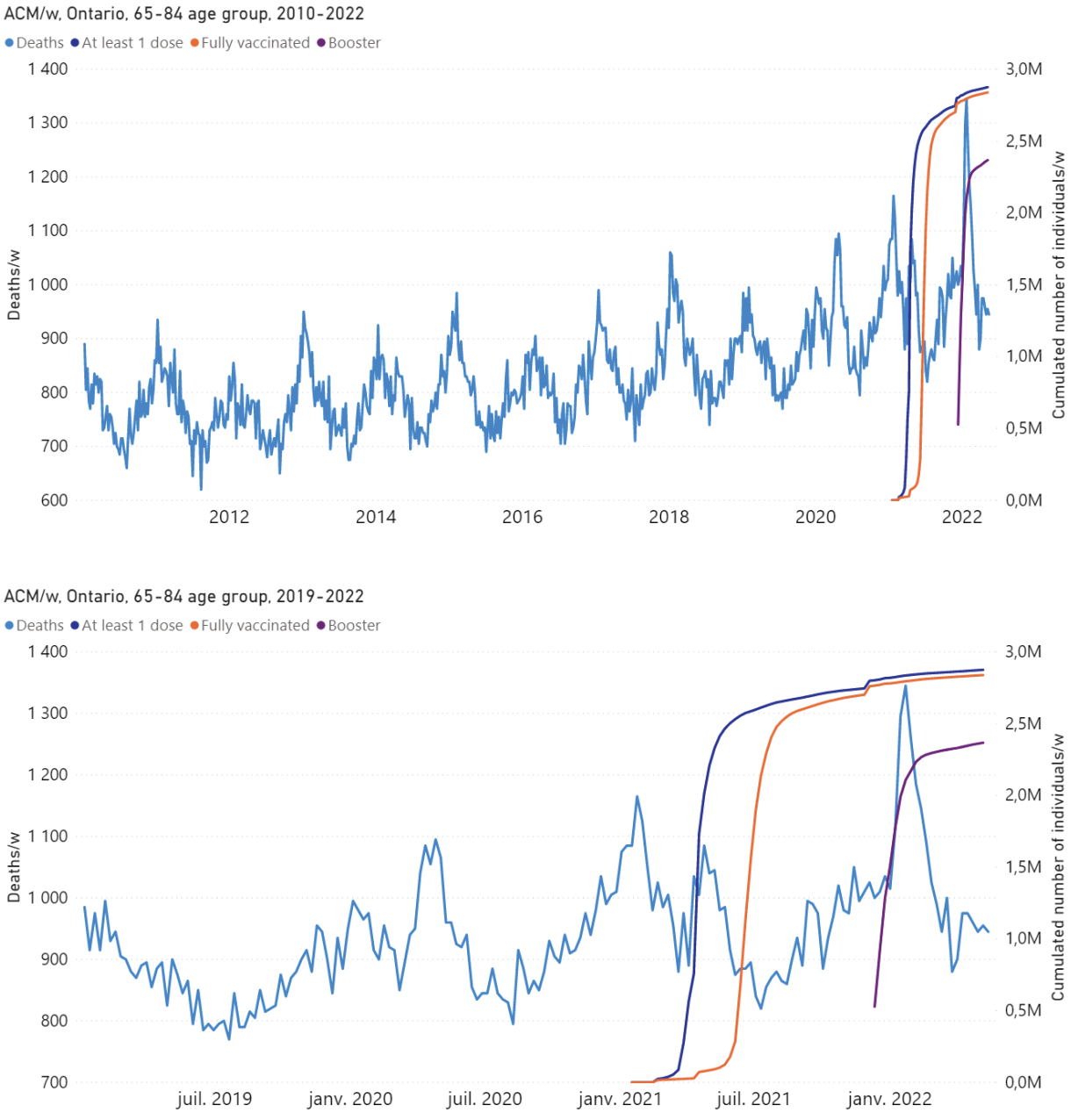

Figure 9: All-cause mortality by week (light-blue), cumulative number of people with at least one dose of vaccine (dark-blue), cumulative number of fully vaccinated people (orange) and cumulative number of people with a booster dose (purple) by week from 2010 to 2022 (upper panel), and from 2019 to 2022 (lower panel), in the province of Ontario, Canada. Both mortality and vaccination are for the age group 65-84 years. (Rancourt et al., manuscript in preparation)

A clear non-seasonal peak is seen in this age group (65-84 years) in Ontario, which is synchronous with the COVID-19 vaccine rollout to this age group (Figure 9); and a particularly large and sharp mortality peak is synchronous with the booster rollout to this age group the following winter season (Figure 9). Here, again, the corresponding COVID-19 vIFRs are comparable in value to that for the vaccination period for Australia (0.05 %).

As further discussion, we make the following observations and comments.

As outlined above, less than and approximately half of the excess deaths of all causes in the vaccination period are deaths registered as COVID-19 deaths. The COVID-19-registered deaths have the following properties (Australian Bureau of Statistics, 2022c):

i. Attribution of death “from COVID-19” versus “with COVID-19” is based on a qualitative evaluation susceptible to bias
ii. 95.4 % of deaths “from COVID-19” in Australian death certificates had non-COVID-19 “causal sequences of events” and/or “pre-existing chronic conditions”
iii. The deaths statistics by age and sex are typical of all-cause old-age deaths statistics in Western societies
iv. The three “most commonly certified acute disease outcomes of COVID-19” were: pneumonia (61.4 %), respiratory failure (15 %), and other infections (11.2 %)
v. The three most common pre-existing conditions in certified “with COVID-19” deaths were: chronic cardiac conditions (39.0 %), dementia (30.5 %), and chronic respiratory conditions (17.8 %)

Therefore, it is reasonable to infer that the vaccine injections caused death by providing an additional and significant challenge to already chronically frail or vulnerable subjects,

and that COVID-19 itself may not have provided a significant contribution, as we already demonstrated for the Southern states of the USA (Rancourt et al., 2022), and as is apparent for India (Rancourt, 2022).

In this context, and given the “most commonly certified acute disease outcomes of COVID-19”, it is important to note that Australia, like virtually all Western jurisdictions, dramatically reduced its antibiotic prescriptions after a pandemic was declared by the WHO (Gillies et al., 2021; Rancourt et al., 2022). This would mean that, not only were chronically frail residents challenged with the toxic injections, but they may also not have been provided the normal treatments against respiratory bacterial infections.

Finally, we note that there is starting to be some acknowledgement in the mainstream media suggesting that vaccine harm in Australia may be much larger than generally admitted by the medical establishment. The recent public testimony and submission to Parliament of former federal MP and former Australian Medical Association (AMA) president Dr. Kerryn Phelps stands out in this regard (Chung, 2022).

In conclusion, the declared pandemic would have had to entirely spare Australia any detectable deaths for more than a year, while it raged in many other places around the world, before it showed any virulence, suddenly in mid-April 2021, when vaccines coincidentally were being rolled out to the elderly and most vulnerable. In addition, a sharp peak in all-cause mortality (mid-January to mid-February 2022) would be synchronous with the rapid deployment of the vaccine booster (3rd doses) purely by coincidence, without any explanation (plausible or not) being provided.

On the contrary, our analysis leads us to conclude that the excess mortality in the vaccination period (31±1 thousand deaths, mid-April 2021 through August 2022; 14 % larger all-cause mortality than in recent pre-vaccination periods of same time duration; 62 million administered vaccine doses), which is more than twice the deaths registered as from or with COVID-19, and the sharp peak in all-cause mortality (mid-January to

mid-February 2022; 2,600 deaths), which is synchronous with the rapid rollout of the booster (9.4 million booster doses, same time period) are causally associated with the COVID-19 vaccine. We give thirteen numbered arguments as to why we make this conclusion.

The corresponding vaccine injection fatality ratio (vIFR) is approximately 0.05 %, which is intermediate between the value from VAERS for ages 65+ years with the Janssen vaccine in the USA (0.008 %) and the value for India's vaccine rollout and for Southern states of the USA subjected to "vaccine equity" campaigns (1 %).

Of course, this is diametrically opposite to the proposal that the COVID-19 vaccine would have saved any lives; a proposal that is not substantiated by extensive study of all-cause mortality data (Rancourt et al., 2022).

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APPENDIX 1:
Step-wise increase in all-cause mortality occurs in mid-April 2021 in all the states in Australia

Here, we show the all-cause mortality data for Australia and for each state of Australia (as labelled in the panels of Figure A1-F1), and including the 72-week vaccination period integrations, described in the present article.

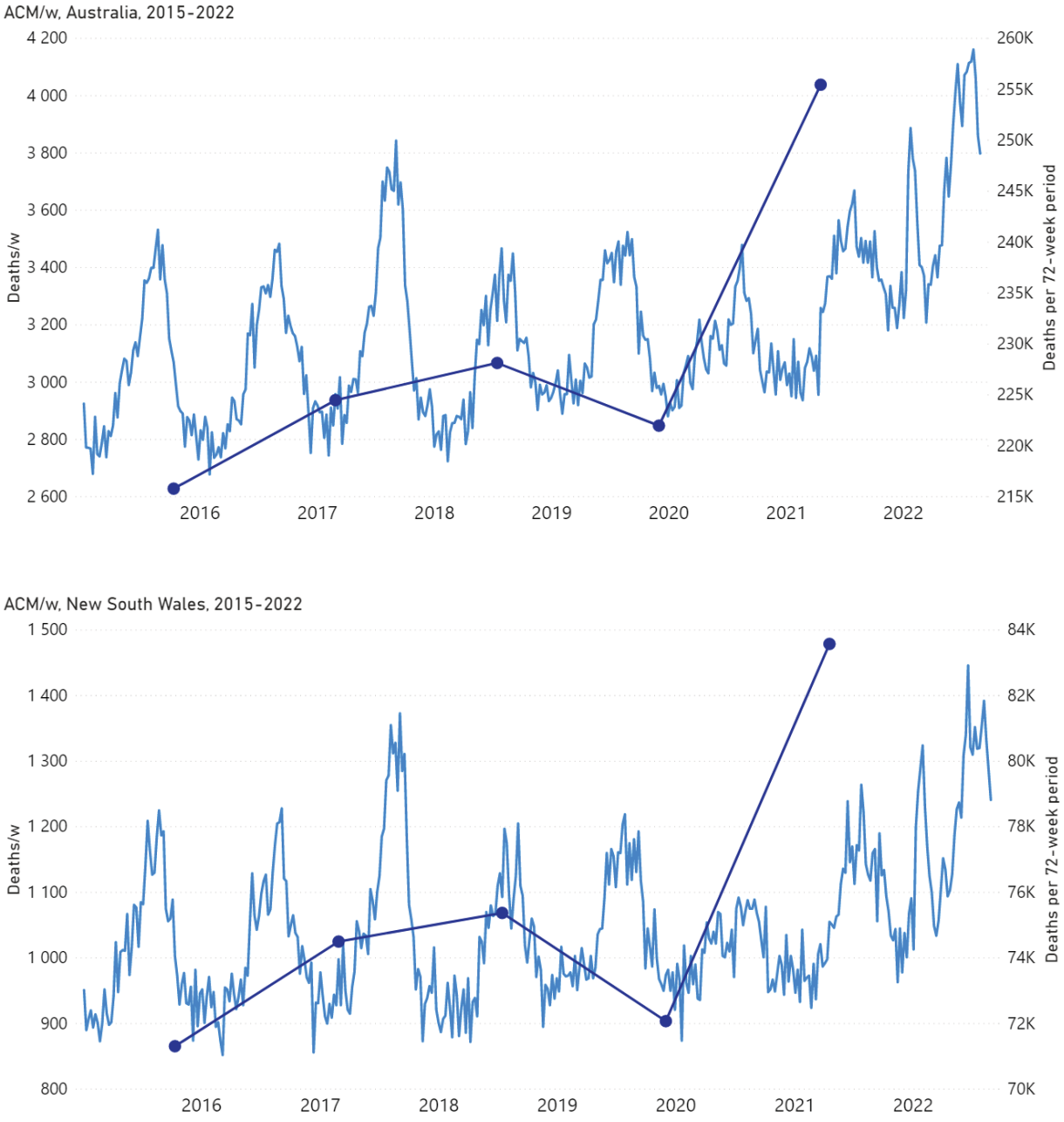
We also provide the following table of corresponding vaccine-period excess mortalities.

Table A1-T1: Integrated all-cause mortality (72 weeks), differences and ratios

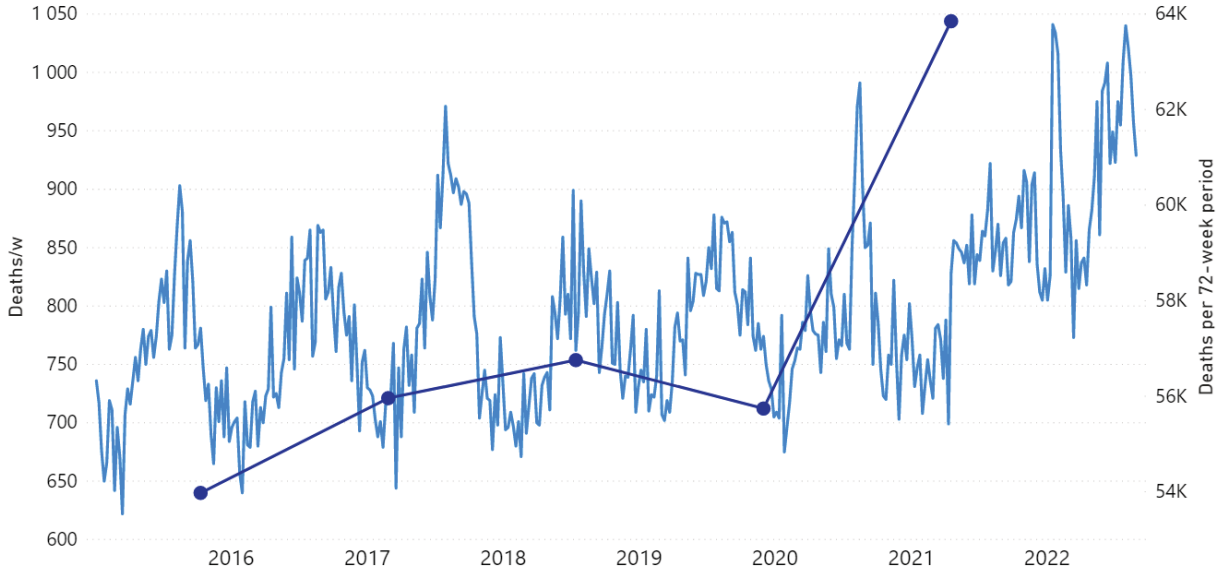
State	Population (M) (2022)	Baseline Period (K)*	Vaccination Period (K)	Excess (K)	Excess /Baseline (%)	Excess deaths (per 100K)
Australia	25.979	224.5	255.5	31.0	13.8	119
NSW	8.154	74	83.6	9.6	13.0	120
VIC	6.614	56.0	63.85	7.85	14.0	120
QLD	5.322	43.9	51.1	7.2	16.4	135
SA	1.821	19	21.3	2.3	12.1	130
WA	2.785	20.8	23.2	2.4	11.5	86
TAS	0.572	6.2	7.0	0.8	12.9	140
NT	0.251	1.57	1.67	0.1	6.4	40
ACT	0.457	3.22	3.74	0.52	16.1	110

* The baseline-period 72-week-integrated mortality was estimated from an inspection of the values on the graphs (Figure A1-F1) for periods prior to the vaccination period, in such a way as to be representative of the value that would be predicted in the absence of the vaccination campaign and its effects.

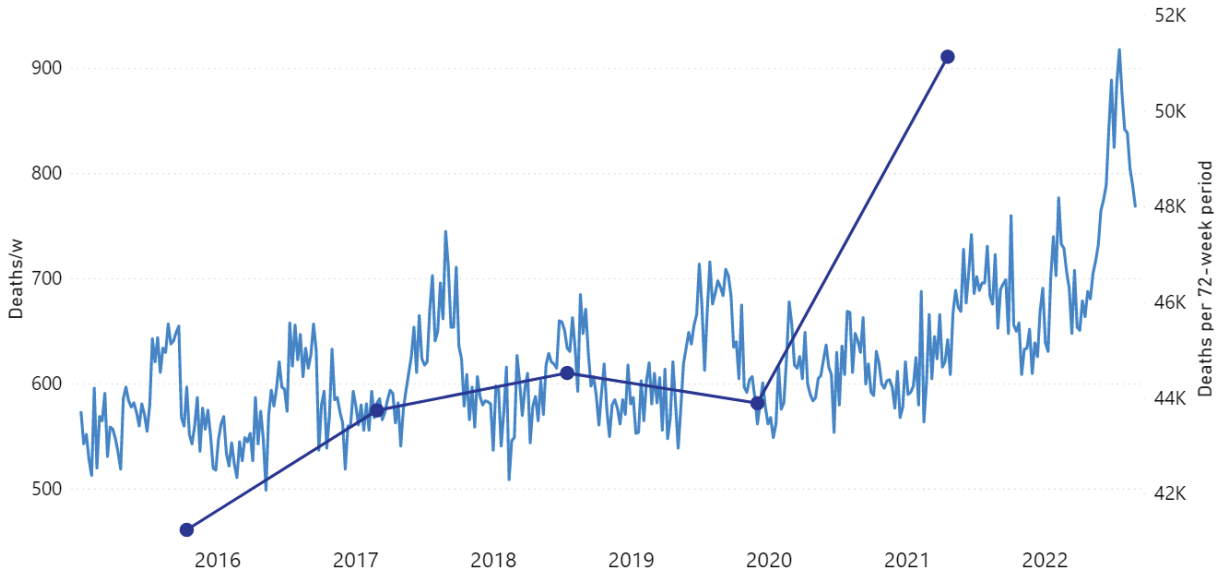
Figure A1-F1 (containing 9 panels) follows.



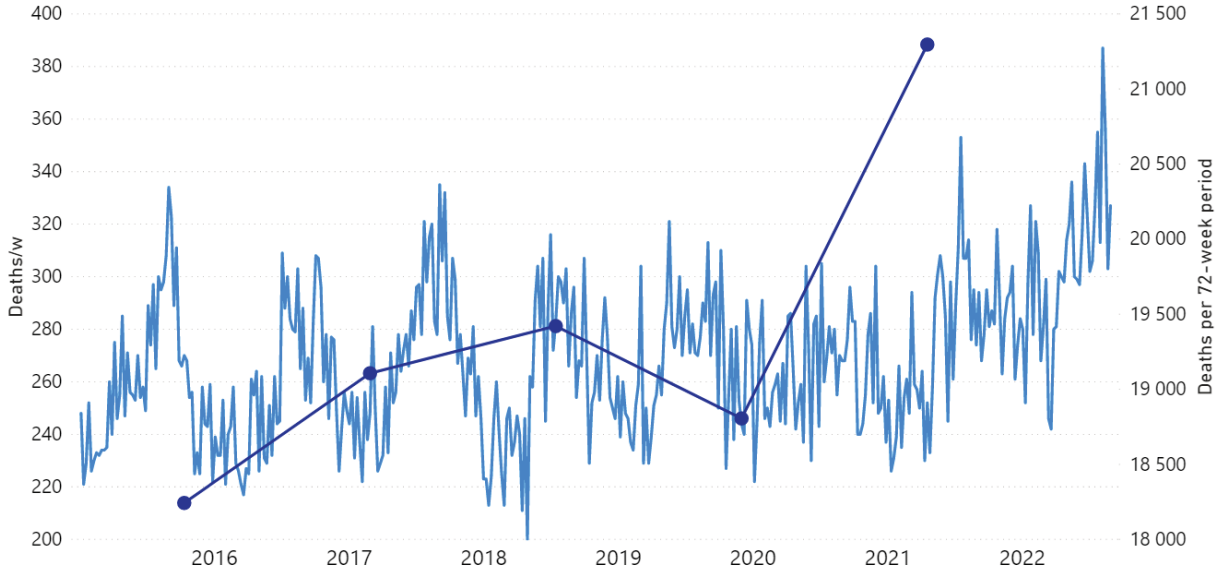
ACM/w, Victoria, 2015-2022



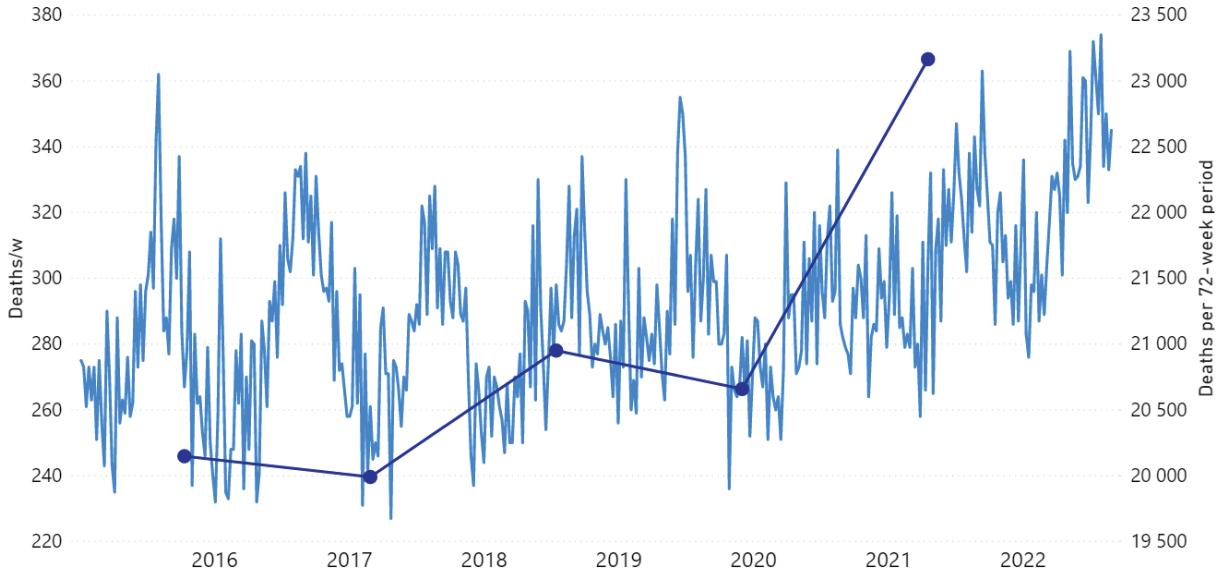
ACM/w, Queensland, 2015-2022

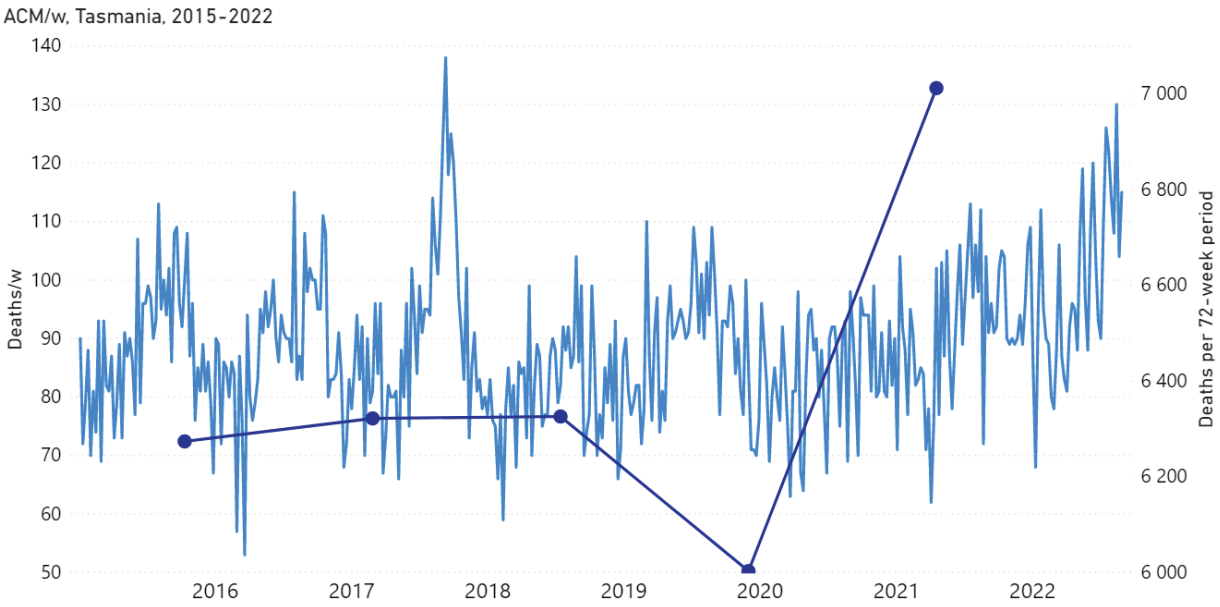


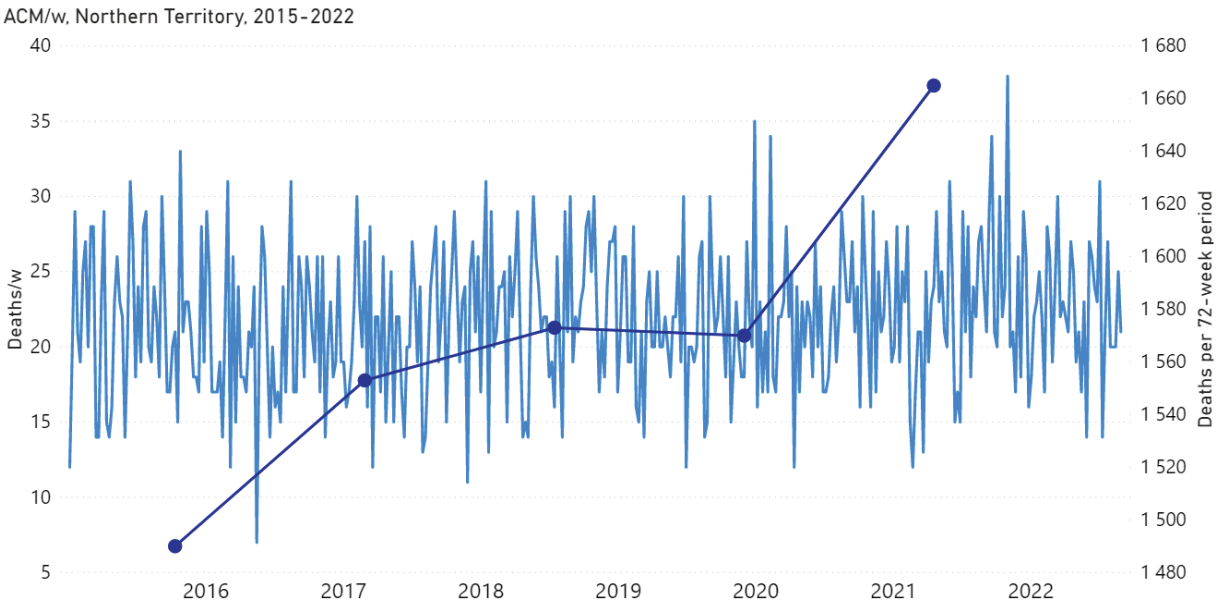
ACM/w, South Australia, 2015-2022

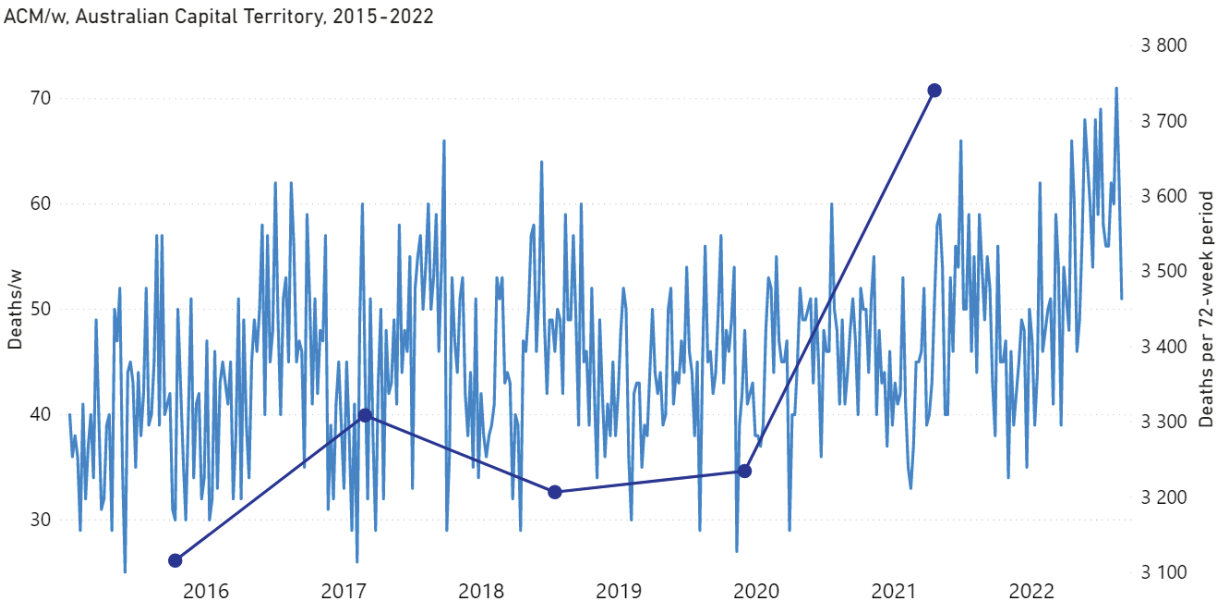


ACM/w, Western Australia, 2015-2022




ACM/w, Tasmania, 2015-2022
Deaths/w
Deaths per 72-week period
140
130
120
110
100
90
80
70
60
50
7 000
6 800
6 600
6 400
6 200
6 000
2016
2017
2018
2019
2020
2021
2022


ACM/w, Northern Territory, 2015-2022
Deaths/w
Deaths per 72-week period
40
35
30
25
20
15
10
5
1 680
1 660
1 640
1 620
1 600
1 580
1 560
1 540
1 520
1 500
1 480
2016
2017
2018
2019
2020
2021
2022


ACM/w, Australian Capital Territory, 2015-2022
Deaths/w
70
60
50
40
30
3 800
3 700
3 600
3 500
3 400
3 300
3 200
3 100
Deaths per 72-week period
2016
2017
2018
2019
2020
2021
2022

APPENDIX 2:
Mid-January to mid-February 2022 mortality peak not caused by a heatwave

This appendix is concerned with the question of whether the mid-January to mid-February 2022 prominent peak in all-cause mortality in Australia (occurring in NSW, VIC and QLD; see Appendix 1) can be due to a climatic heatwave.

It is important to address this question because sharp all-cause mortality peaks are often associated with exceptional summer heatwaves in mid-latitude countries (e.g. Rancourt et al., 2022, cited in the present article).

The most important heatwave to affect Eastern Australia over more than the last three decades was in 2009. The government report [Australian Government - Bureau of Meteorology, Special Climate Statement 17: The exceptional January-February 2009 heatwave in south-eastern Australia (issued 4 February 2009, updated 12 February 2009), http://www.bom.gov.au/climate/current/statements/scs17d.pdf , accessed 18 December 2022] describes it this way:

> "An exceptional heatwave affected south-eastern Australia during late January and early February 2009. The most extreme conditions occurred in northern and eastern Tasmania, most of Victoria and adjacent border areas of New South Wales, and southern South Australia, with many records set both for high day and night time temperatures as well as for the duration of extreme heat.
>
> There were two major episodes of exceptional high temperatures, from 28-31 January and 6-8 February, with slightly lower but still very high temperatures persisting in many inland areas through the period in between."

This exceptional 2009 heatwave did not cause any significant peak in all-cause mortality, as shown in Figure A2-F1, below. In fact, heatwaves essentially do not cause peaks in all-cause mortality in Australia, presumably because it's always hot in the

summers. Figure A2-F1 does not show any peaks, 1980-2022, which could be interpreted as summer heatwave peaks.

Also, there are no Australian Government, Bureau of Meteorology, Special Climate Statements (SCSs) 2006-2022, which can be interpreted to be associated with or similarly associated to the mid-January to mid-February 2022 prominent peak in all-cause mortality occurring in Eastern Australia (NSW, VIC, QLD) (see Appendix 1). See the list of SCSs here: http://www.bom.gov.au/climate/current/statements/ . Archived on 18 December 2022 here: https://archive.vn/WDlPA

And the Australian Government, Bureau of Meteorology, "Monthly Weather Review, Australia, January 2022" report [Product code IDCKGC1AR1. Prepared on 27 April 2022. http://www.bom.gov.au/climate/mwr/aus/mwr-aus-202201.pdf] makes no mention of any climate or weather event that could be associated with the mid-January to mid-February 2022 prominent peak in all-cause mortality occurring in Eastern Australia (NSW, VIC, QLD).

That the 2022 all-cause mortality peak of concern is not due to a heatwave is again corroborated by the fourteen maximum daily temperature maps for Australia shown below, for the years and dates as indicated on the maps.
[Source: http://www.bom.gov.au/climate/ . Specifically:
http://www.bom.gov.au/jsp/awap/temp/rmse_archive.jsp?map=maxave&period=daily&year=2022&month=1&day=12]

The mid-January to mid-February 2022 prominent peak in all-cause mortality occurring in Eastern Australia (NSW, VIC, QLD) (see Appendix 1) — seen in Figure A2-F1 and in Figures 1, 2, 4A and 6 of the present article — is not due to any climate, weather or temperature event or anomaly.

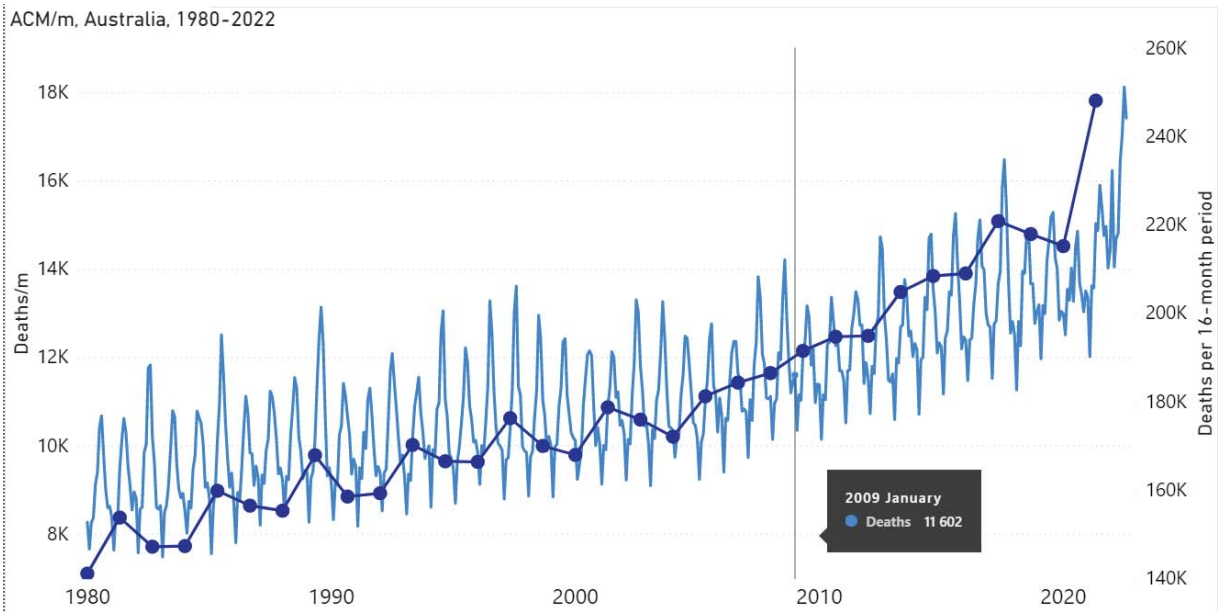
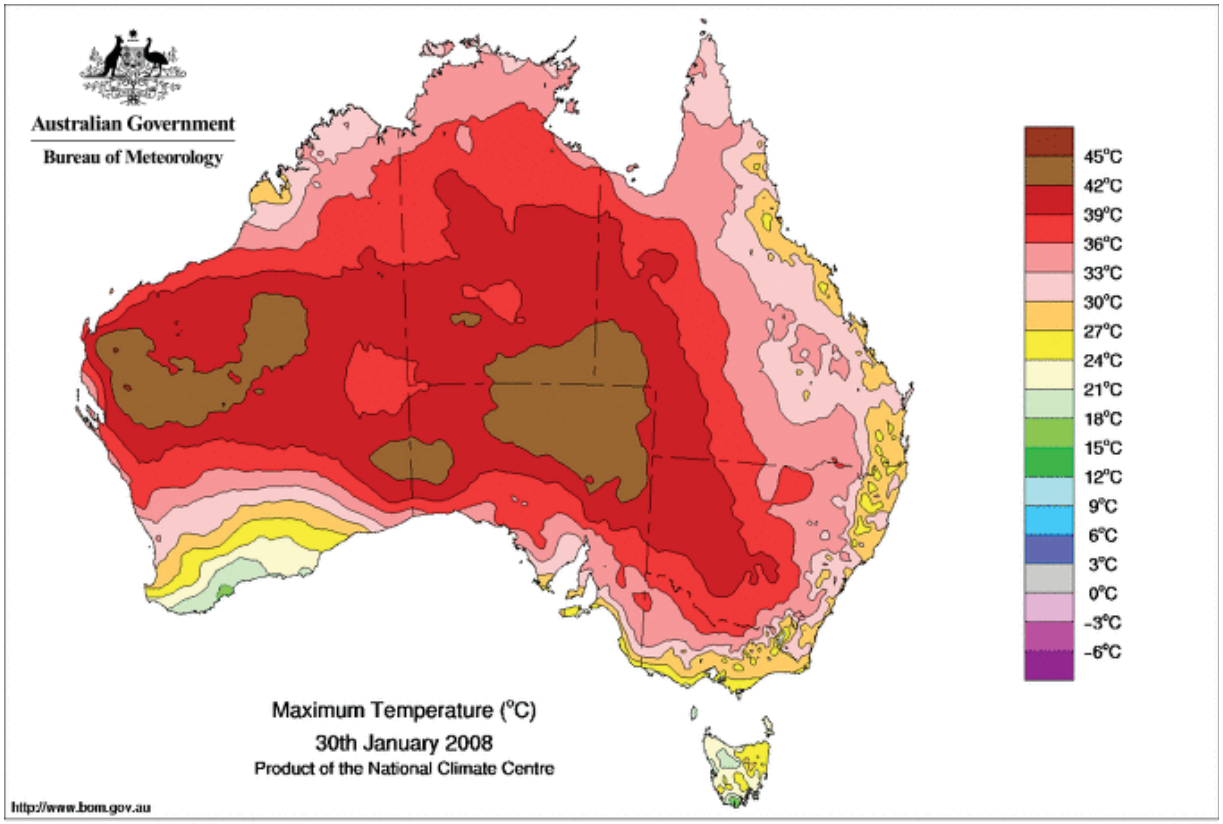


Figure A2-F1: All-cause mortality in Australia, all ages, from January 1980 through August 2022. Light-blue: All-cause mortality by month, left y-scale. Dark-blue: Integrated all-cause mortality over successive and non-overlapping 16-month periods (May 2021 through August 2022, for most recent period), right y-scale. Each point is positioned on the x-axis at the 1st month of its 16-month integration period. The labelled vertical line shows January 2009, which had a record-breaking heatwave and virtually no associated increase in mortality. February has lower mortality because it generally has only 28 days. (Data source: Australian Bureau of Statistics (2022a) for 2015-2022; United Nations (2022) for 1980-2014.)



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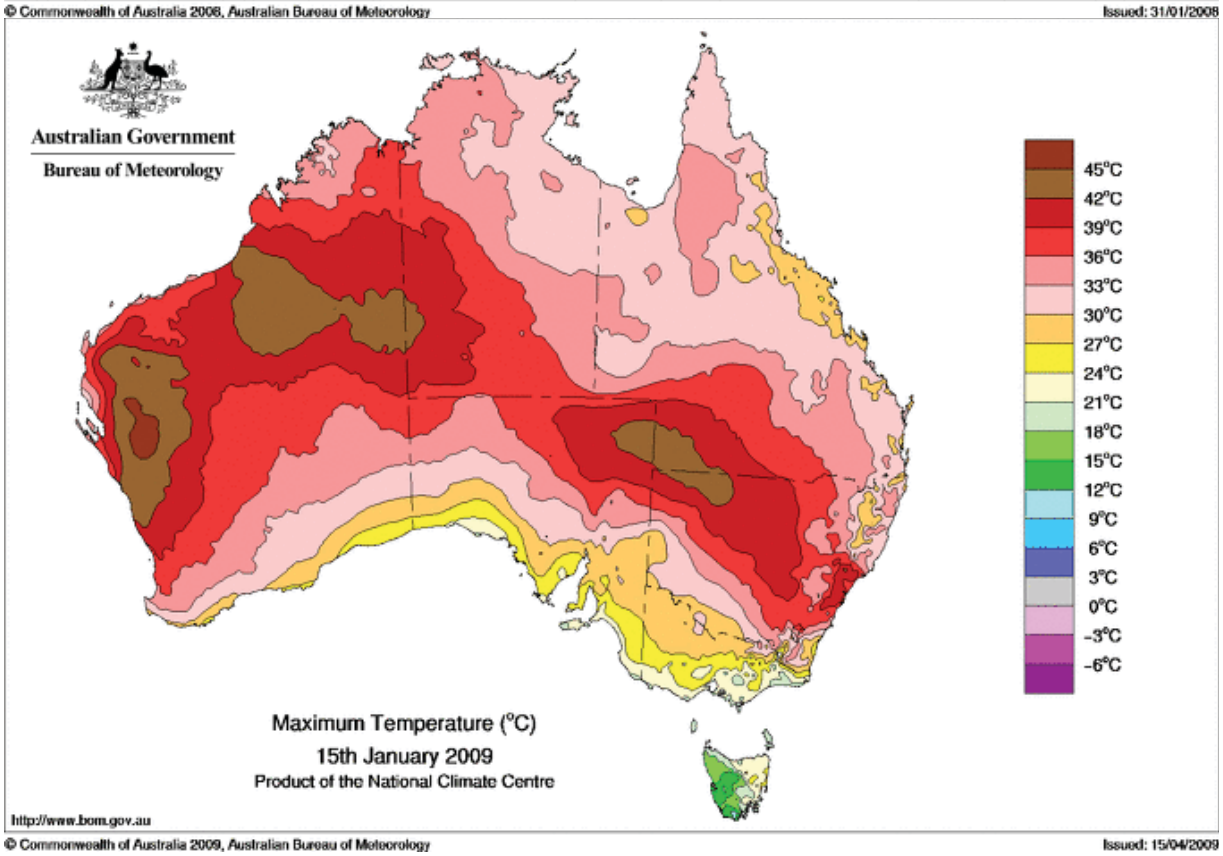

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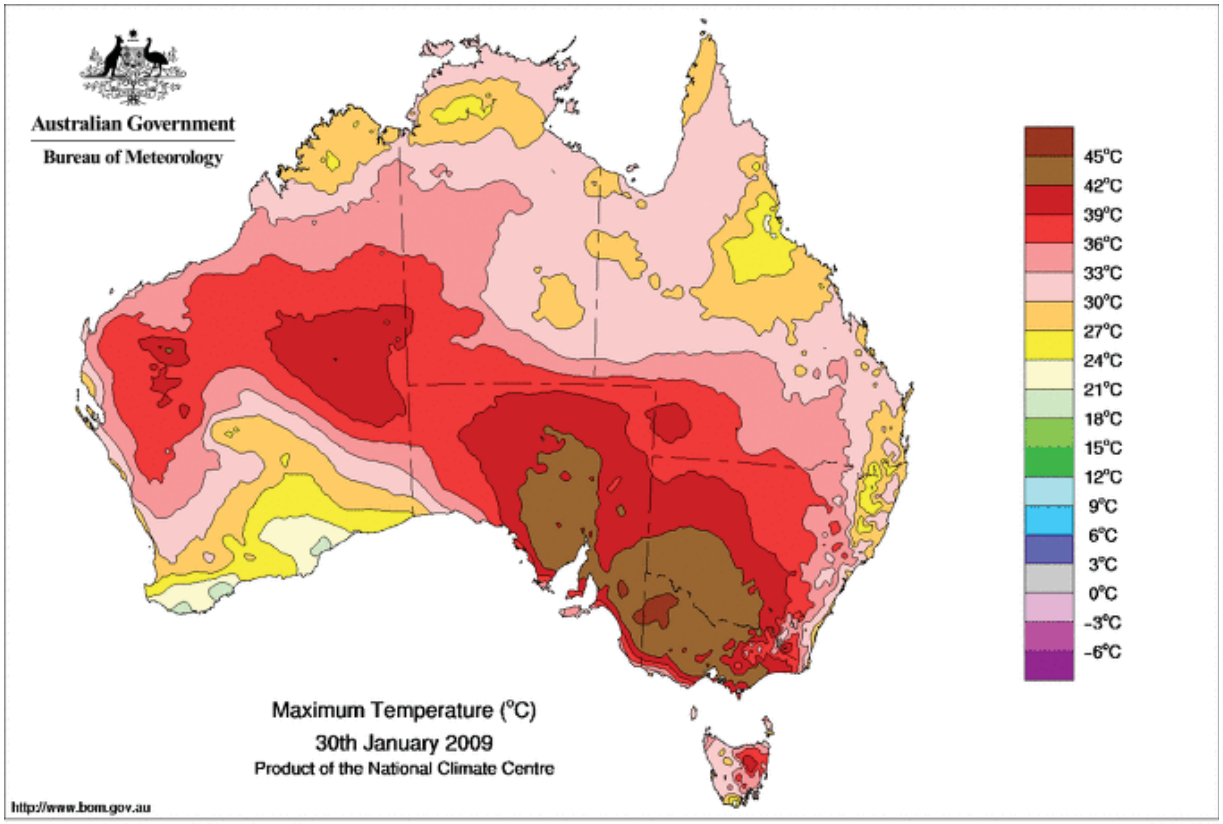

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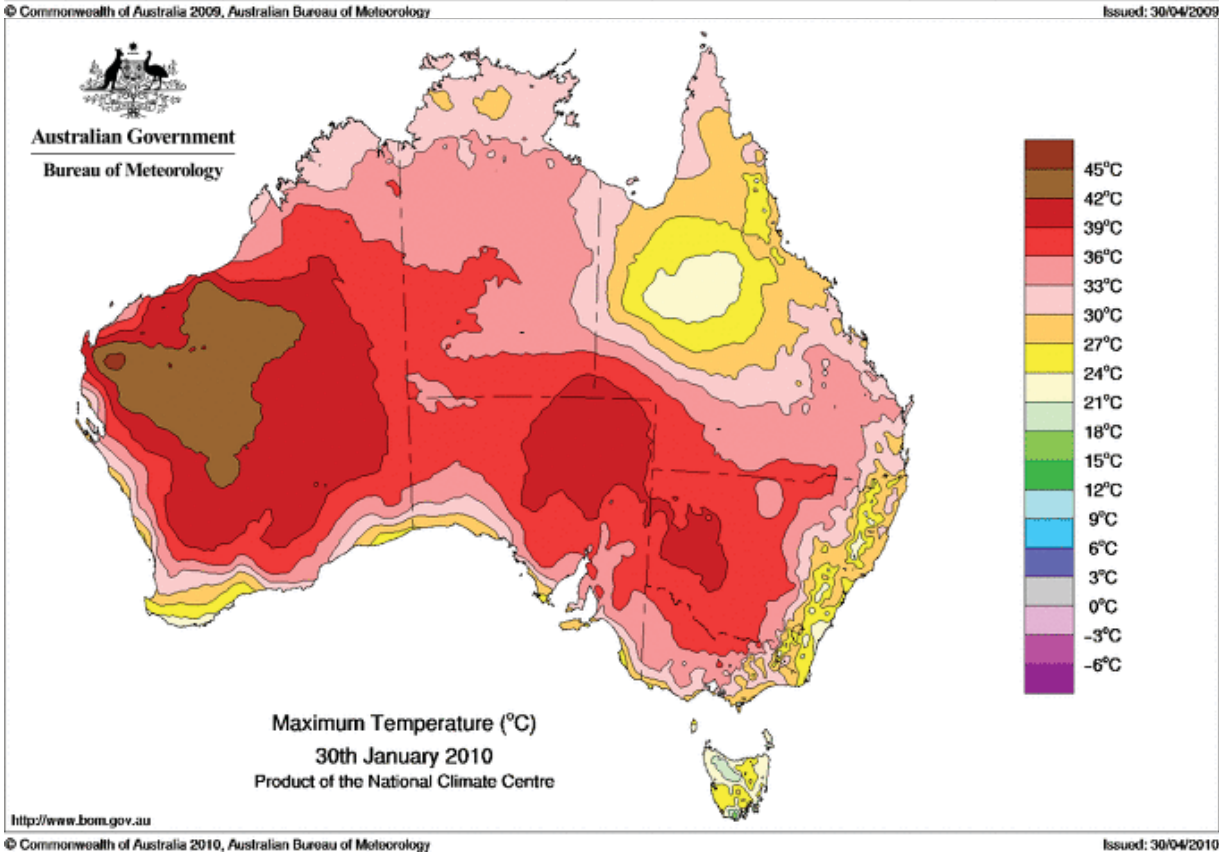
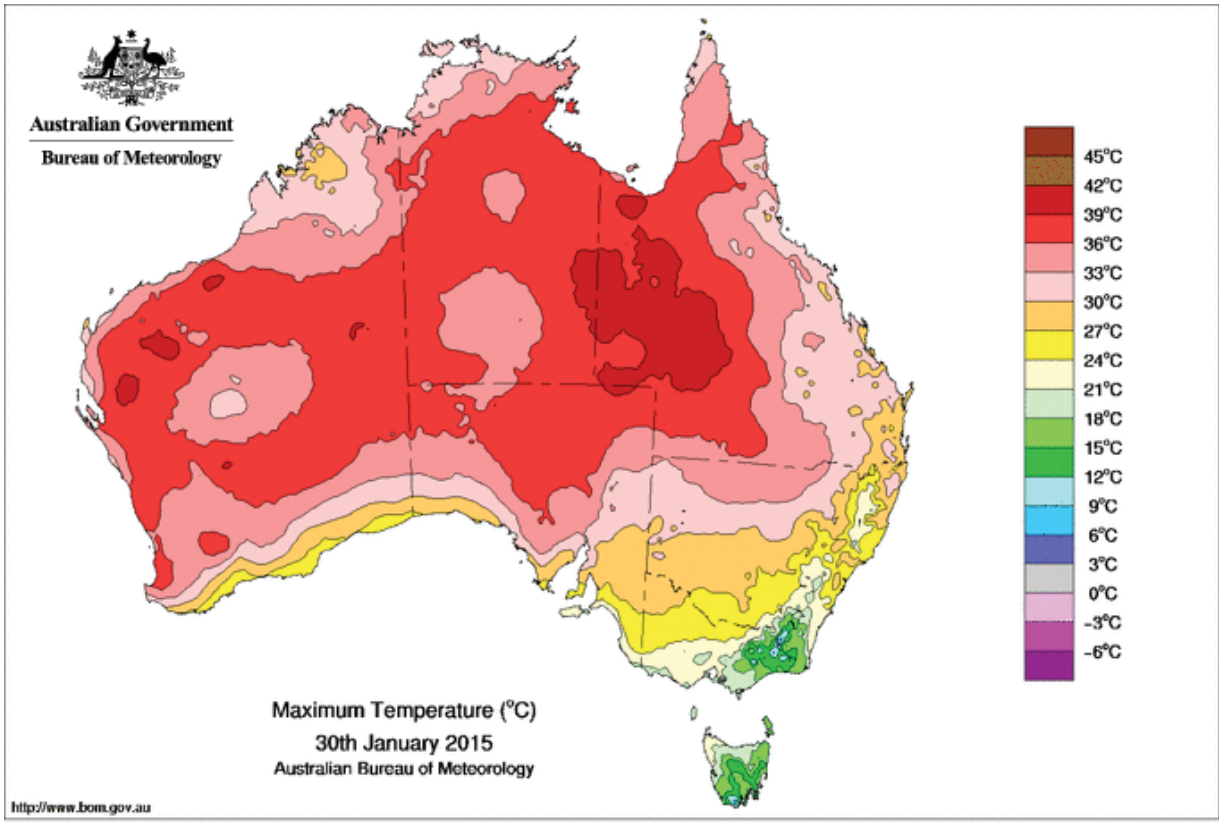


Issued: 30/04/2010


Australian Government
Bureau of Meteorology
45°C
42°C
39°C
36°C
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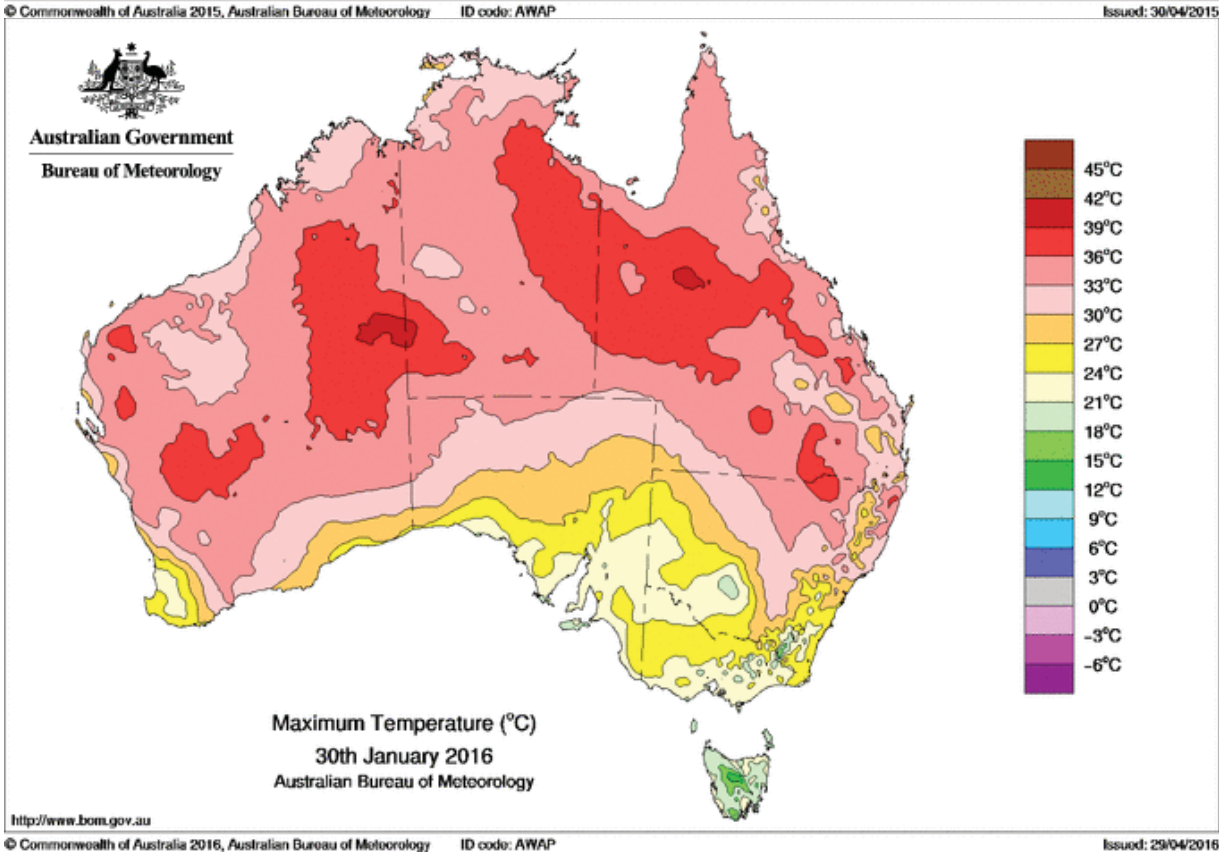
30°C
27°C
24°C
21°C
18°C
15°C
12°C
9°C
6°C
3°C
0°C
-3°C
-6°C
Maximum Temperature (°C)
30th January 2015
Australian Bureau of Meteorology
http://www.bom.gov.au
© Commonwealth of Australia 2015, Australian Bureau of Meteorology
ID code: AWAP
Issued: 30/04/2015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Bureau of Meteorology
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6°C
3°C
0°C
-3°C
-6°C
Maximum Temperature (°C)
30th January 2016
Australian Bureau of Meteorology
http://www.bom.gov.au
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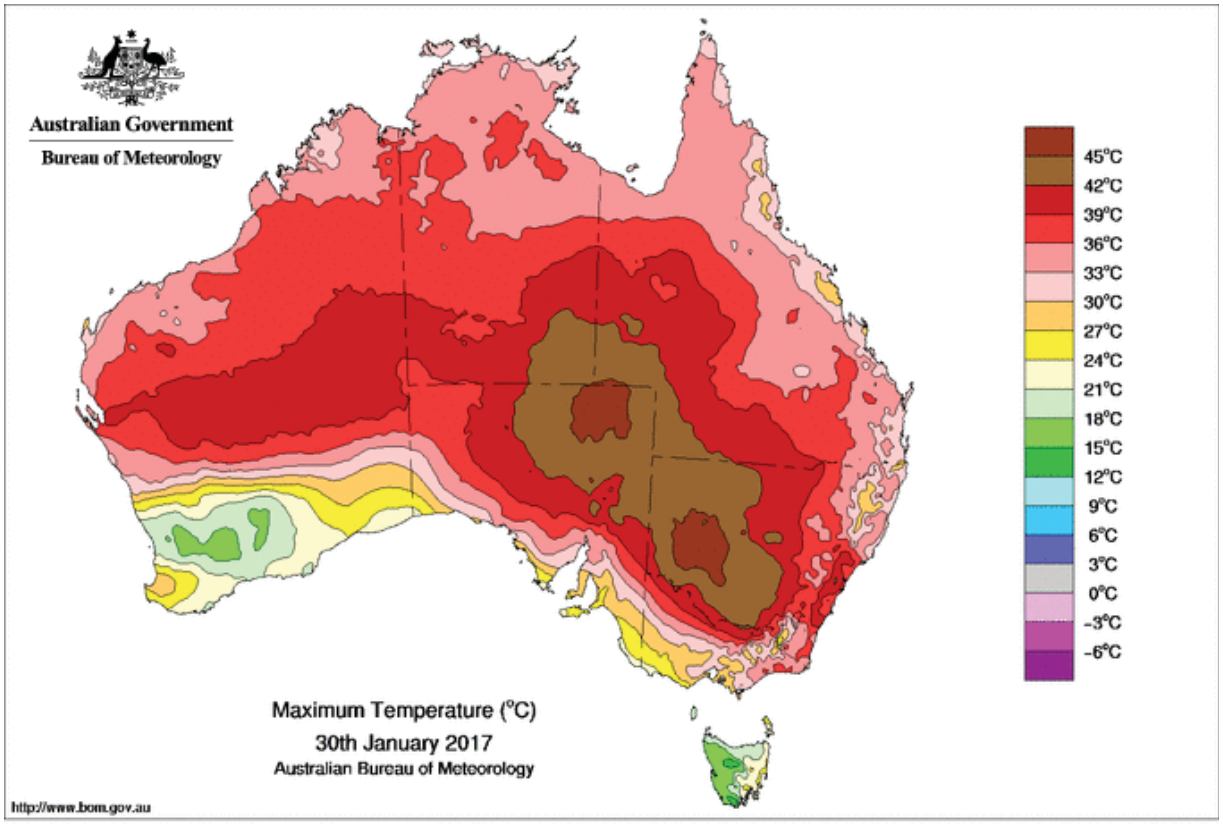
ID code: AWAP
Issued: 29/04/2016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Australian Bureau of Meteorology
http://www.bom.gov.au
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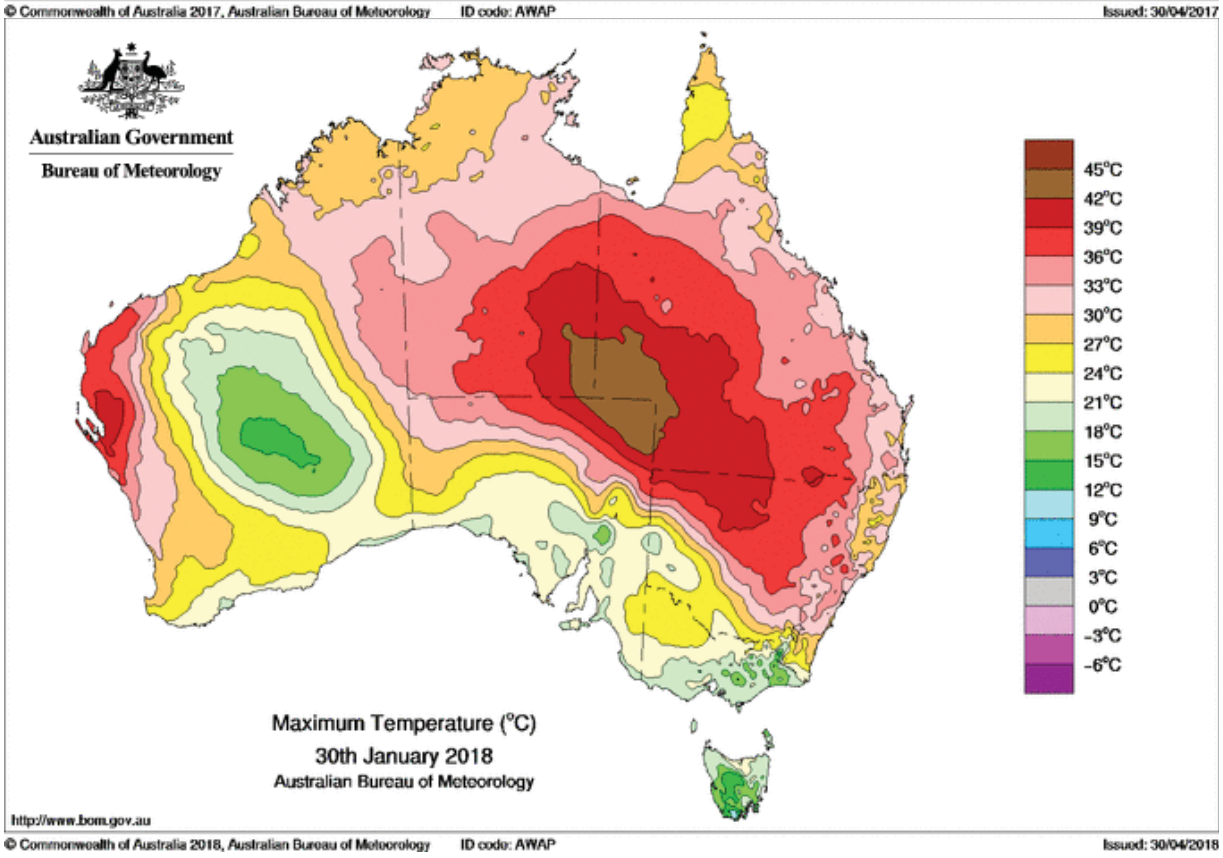
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Bureau of Meteorology
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Maximum Temperature (°C)
30th January 2018
Australian Bureau of Meteorology
http://www.bom.gov.au
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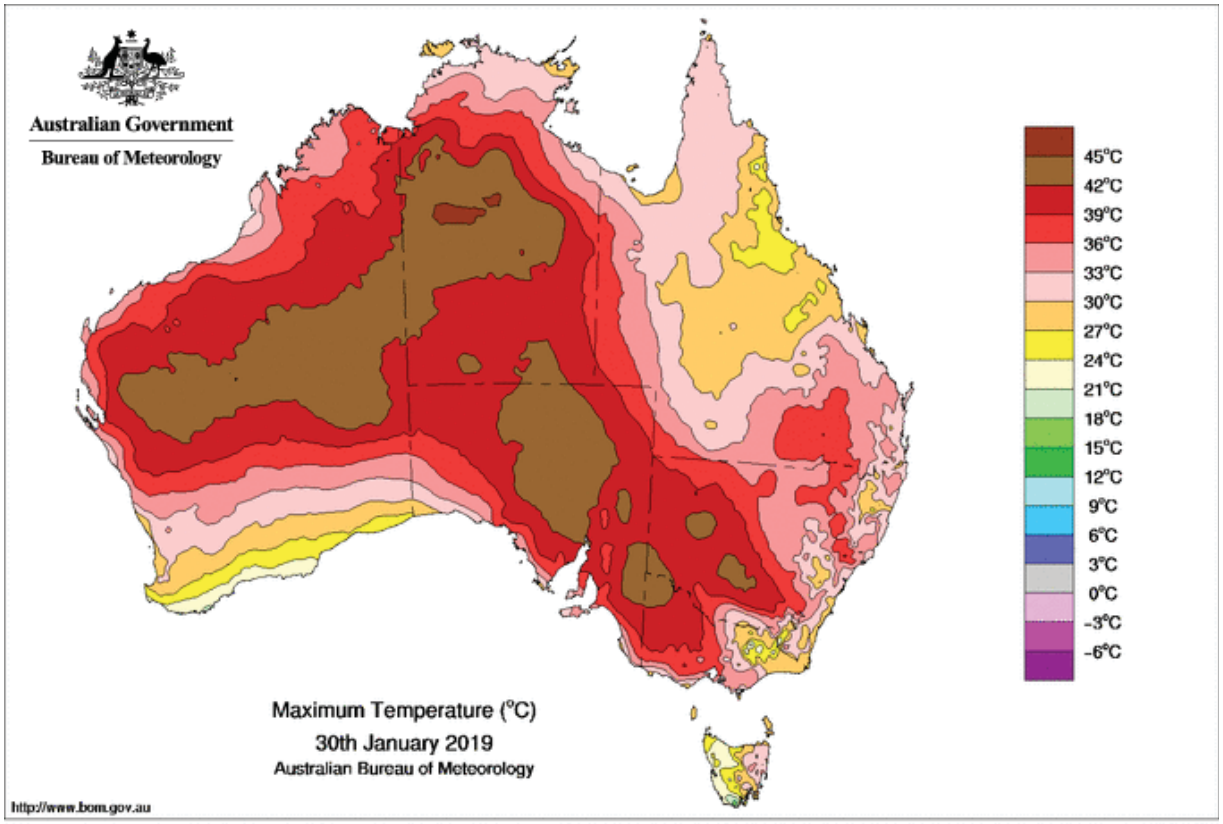
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Maximum Temperature (°C)
30th January 2019
Australian Bureau of Meteorology
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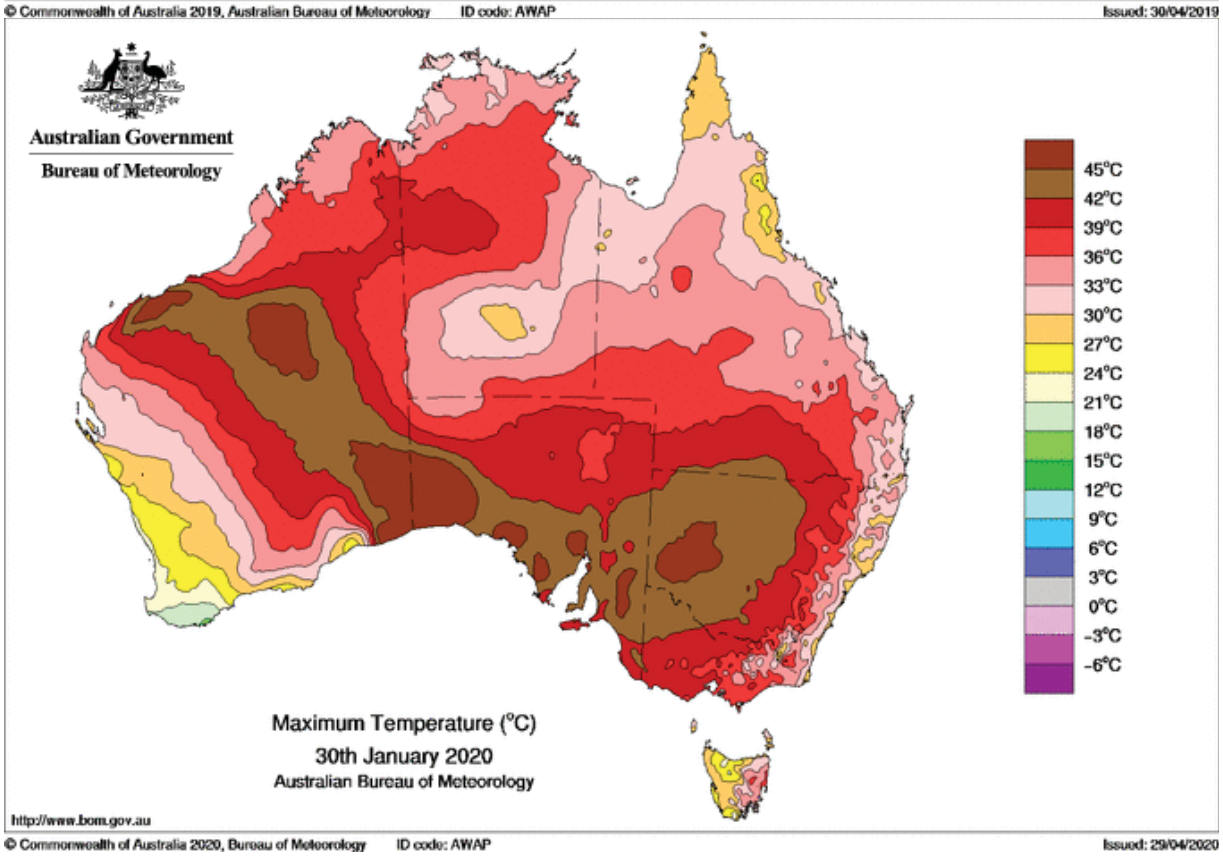
Issued: 30/04/2019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Maximum Temperature (°C)
30th January 2020
Australian Bureau of Meteorology
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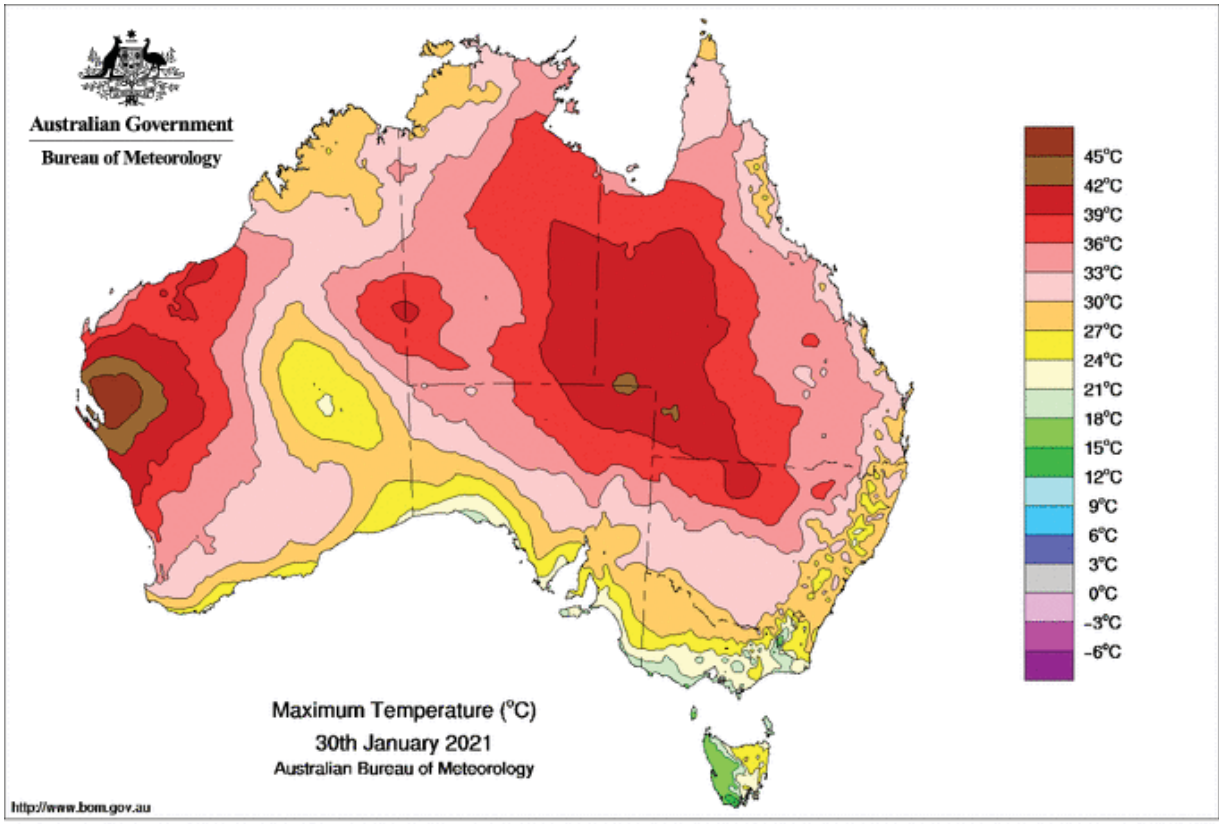
Issued: 29/04/2020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Maximum Temperature (°C)
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Australian Bureau of Meteorology
http://www.bom.gov.au
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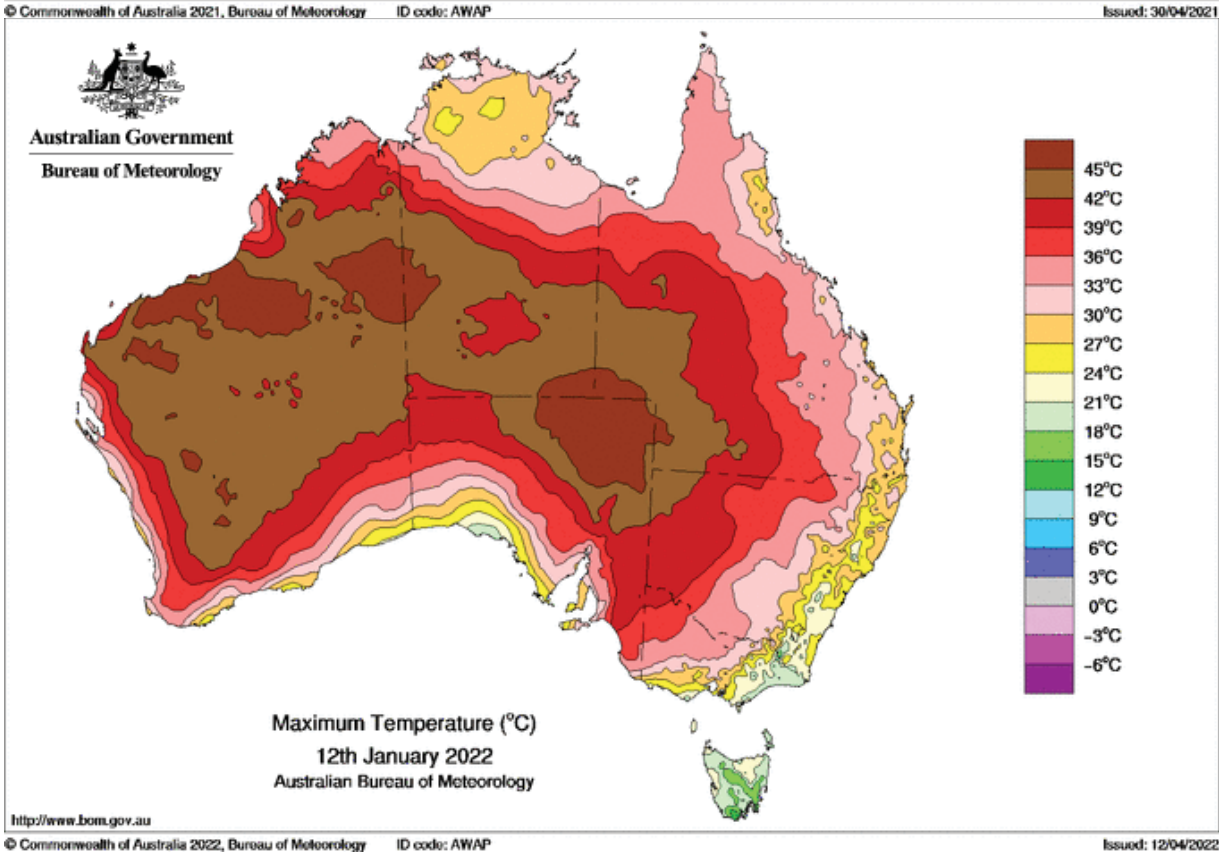
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Maximum Temperature (°C)
12th January 2022
Australian Bureau of Meteorology
http://www.bom.gov.au
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ID code: AWAP
Issued: 12/04/2022