Special Article

Public Health Policies Regarding the COVID-19 Pandemic Management: The Cases of Australia, New Zealand, Singapore, Finland and Iceland

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Abstract
Background: The high contagiousness of the SARS-CoV-2, the large proportion of the population at risk of serious illness which will require hospital care and, certainly, the necessary need to protect public health has led countries worldwide to quickly resolve measures.

Aims: Public health policies regarding the COVID-19 pandemic management of Australia, New Zealand, Singapore, Finland and Iceland.

Methods: A narrative literature review was conducted. The evaluation of the effectiveness of the countries' health policies was carried out using three indicators: the Case Fatality Rate (CFR), the number of cases and the number of deaths per 100,000 people.

Results: The very fast response of the governments, the strict lockdown, the quarantine measures, the travel restrictions, the systematic testing, tracing and epidemiological surveillance, the effective communication between officials and citizens, the government's response to COVID-19 focused on allowing the relevant experts to convey important information directly to the public, the testing of older people and health professionals and the mobile tracing applications compose the most important public health interventions. All these measures combined with the adoption and implementation by the citizens and with the organization of health systems, resulted in better management of the pandemic in the countries under study.

Discussion: These measures have undoubtedly been important public health policies, which are a testament to future responses to such pandemics.

Keywords: Australia, COVID-19, Finland, Iceland, New Zealand, Public health policies, pandemic, Singapore.

Introduction

In late 2019, there was the beginning of the largest pandemic of modern times to this day. More particularly, cases of coronavirus and the new coronavirus called SARS-CoV-2 were identified for the first time in the Chinese city of Wuhan. The infection was named COVID-19 (World Health Organization, 2020).The high contagiousness of the virus, the modern way of life with the accumulation of the population in densely populated cities, the gatherings for social and professional purposes, as well as travelling from country to country for work, trade, education or tourism, resulted in the rapid spread of the virus on all continents within a few months.

International health systems were under intense pressure, namely the secondary hospital care, which required the rapid development of nursing departments and intensive care units exclusively for COVID-19 patients. According to the WHO, 20% of those who tested positive for coronavirus will develop symptoms and will require admission to hospital (WHO, 2020). Also, a percentage of those admitted to the hospital will need hospitalization in an Intensive Care Unit and some will unfortunately pass away (Killerby et al., 2020; Giannouchos, Sussman, Mier, Poulas, & Farsalinos, 2020; Richardson et al., 2020; Price-Haywood, Burton, Fort, & Seoane, 2020). Patients from vulnerable population groups have a higher risk of hospitalization, more serious illness and admission to an ICU or even death. These patients put a burden on health systems, as their hospitalization and care is more demanding and, in case of admission to an ICU, the cost for the health systems is much higher.

Many studies conducted in Covid-19 infected patients identified the subgroups of the population which are most likely to be severely affected by the disease. In particular, males, elderly and chronic illness patients (co-morbidity): patients with chronic renal insufficiency (CRI), diabetes, Chronic Obstructive Pulmonary Disease (COPD), hypertension, immunosuppressed patients, obese patients, patients with cardiovascular diseases, cancer, liver disease, Cerebral Vascular Event (CVE) patients, dementia patients and patients with various neurological diseases (Giannouchos et al., 2020; Wu & McGoogan, 2020; Esai Selvan, 2020; Yang et al., 2020; Chen et al., 2020).

The high contagiousness of the virus, the large proportion of the population at risk of serious illness which will require hospital care and, certainly, the necessary need to protect public health has led countries worldwide to quickly resolve measures. These included personal protective measures such as a face mask, physical distance and hand hygiene. In addition to the individual prevention measures, governments have taken a number of measures to control and contain the pandemic, which included all the activities of citizens' lives. These measures included the implementation of quarantine at local and national level, the shutdown of commercial businesses and school units at all levels of education, the restriction of circulation within the city and between prefectures, the prohibition of activities leading to promiscuity (e.g. sports activities, events of all kinds, the operation of theaters, cinemas, etc.), checks at the entry gates of the country (airports, ports), the implementation of distance education, distance working and the application of measures to businesses whose operation had not been suspended (Chinazzi et al., 2020; Cronin & Evans, 2020; Kraemer et al., 2020; Med Sci et al., 2020; Tian et al., 2020; Xiao & Torok, 2020).

The immediate tracing of close contacts of the infected patients has also played an important role in the control of the pandemic, as it has enabled the immediate detection and isolation of positive contacts and the interruption of the coronavirus contagion chain (Girum et al., 2020). However, the lack of coronavirus screening tests in some countries, such as the USA, has been a major problem and the triptych tracing-quarantine-test was implemented with delay. As a result, the virus remained undetected for a period of time and at the same time the cases were spreading rapidly (Lewis, 2021). Smart phone applications, which have proved effective in this effort, have also contributed to the identification of direct contacts of a positive case or to the awareness of the existence of a positive person in close proximity. Of course mobile applications are complementary to the pandemic control practice as the application of individual protection measures and social restrictions should be applied at the same time

(Almagor & Picascia, 2020; Hernández-Orallo et al., 2020; Kleinman & Merkel, 2020). The early implementation of measures to prevent, diagnose, trace and protect the vulnerable groups of the population and the acceptance of the above measures were fundamental principles in the effort to control the coronavirus pandemic. In this effort, some countries have shown great efficiency, which has resulted in a reduced number of cases and deaths and the protection of public health.

The aim of this review was to present the public health policies of five countries: Australia, New Zealand, Singapore, Finland and Iceland regarding the management of the COVID-19 pandemic.

Methods

Data definitions

The policies presented include up to the third wave of the pandemic, up to May 2021. The first wave of Covid-19 was recorded from March 15th to June 30th, 2020. The second wave includes the period from July 1st to October 15th, 2020. In spring 2021, we were in the third wave of the pandemic, which started in November 2020 (Iftimie et al., 2021), although researchers report that the second wave was not yet over and, effectively, this period was part of the second wave. The selected countries belong to the financially developed countries with a developed trade activity. All countries, except Singapore, are members of The Organisation for Economic Co-operation and Development (OECD). The evaluation of the effectiveness of the countries' health policies was carried out using three indicators: the Case Fatality Rate (CFR), the number of cases and the number of deaths per 100,000 people. With regard to the use of pandemic indicators two important and reliable indicators can be used to assess the seriousness of a disease, its impact and, at the same time, its effective management by governments of countries worldwide. The first indicator is the Case Fatality Rate (CFR), which refers to the percentage of deaths from a specific disease compared to the total number of people diagnosed with the disease for a specific period (ScienceDirect Topics, 2007).

The second indicator that can be used is the Infection Fatality Rate (IFR) and represents the percentage of deaths among all infected people, including all asymptomatic and undiagnosed people (people who have not been tested). We know that a percentage of the Covid-19 infected will not develop any symptoms (asymptomatic carrier), so there will be no diagnosis and recording. Non-recording can also occur in people who have been infected and who are suffering from mild symptoms. Those people are very likely to isolate themselves or, at the urging of supervisory authorities and after the foreseen period of time, to return to social and professional life without a diagnostic test. These events will not be diagnosed in a laboratory and will never get recorded. Detection of these events requires serological testing that detects the presence of antibodies produced by the body against the virus (Levin et al., 2020). As serological examinations are time-consuming, expensive and do not cover large geographical areas, the CFR index was chosen to assess the severity of the disease in the middle of the pandemic.

WHO Coronavirus COVID-19 Dashboard database was used to collect data on the number of cases and deaths per 100,000 inhabitants (World Health Organization, 2021e). The CFR indicator was directly derived from the Coronavirus Resource Center, Johns Hopkins University and Medicine database (Johns Hopkins Coronavirus Resource Center, 2021b).

Country profile and health system overview: Table 1 shows the countries' demographic profile (OECD, 2020; OECD, 2021; The World Bank, 2021e, 2021c, 2021b, 2021d; The World Bank, 2021a; The World Bank, 2021g). According to the country profile, Australia is the least populated country, Singapore is the third most populous country in the world and with the highest per capita income compared to the rest of the study's countries and Finland has the highest population rate over 65 years. Table 2 shows the health systems typology, health costs and healthcare resources of the countries (Singapore at a glance, 2021; The Commonwealth Fund, 2021; The World bank, 2021; The World Bank, 2021c, 2021a; OECD, 2019). Australia spends the largest amount of GDP on health compared to the rest of the countries; Singapore has the largest out-of-pocket health expenditure, while Iceland employs most doctors and nurses in proportion to its population. Table 3 shows statistics on health behaviors and the prevalence of chronic diseases (The World

Bank, 2021a; World Bank, 2021; World Obesity, 2021; OECD, 2019). Finland has the highest overweight and obesity rate compared to the rest of of the countries, Australia has the lowest prevalence of diabetes and Iceland has the least adult smokers. The fourth table presents the three countries' assessment indicators for the management of the COVID-19 pandemic (Johns Hopkins University and Medicine, 2021; World Health Organization, 2021b). Singapore has the lowest CFR with 0.05% as well as the lowest COVID-19 Deaths/100,000 population number with just 0.53 deaths. New Zealand has the lowest COVID-19 cases/100,000 population number with 47.36 cases. Figure 1 shows the number of confirmed cases per million of population for the countries under study until May 11th, 2021 compared to the US equivalent and the average number of countries in Europe (University of Oxford, 2021). According to these results on May 11th, 2021 the average confirmed case value per million of population in Europe was 134.24 and in the USA 114.20. Figure 2 shows the number of deaths per million of population for the countries under study until May 11th, 2021 compared to the US equivalent and the average number of countries in Europe. According to these results on May 11th, 2021 the average COVID-19 deaths per million of population in Europe were 3.19 and in the USA 1.90.

Country Public Health Policies

Australia

The first confirmed case of COVID-19 in Australia was recorded on January 25th, 2020 (World Health Organization, 2021a). Measures to prevent the spread of coronavirus in Australia were immediate and multi-faceted. On February 1, when China was the only country to report contagion and new cases of coronavirus, the Australian authorities restricted all travel from mainland China to Australia in order to reduce the risk of introducing and transmitting the virus in the country. Only Australian citizens and residents (and their dependents) were allowed to travel from China to Australia. These travelers were told to remain in self-quarantine for 14 days since their arrival date. Further border measures, such as increased testing and additional advice, were put in place for arrivals

from other countries, based on a risk assessment tool which was developed in early February (Shearer et al., 2020; Price et al., 2020). The measures were taken because, shortly before their implementation was announced, there were 9 Covid-19 cases linked to a recent trip to the Chinese city of Wuhan, where the first cases were recorded and the pandemic started (2019-nCoV National Incident Room Surveillance Team, 2020). Also 200,000 passengers who were flying from the mainland of China were expected in Australia (Australia Bureau of Statistics, 2021). During February 2020, thanks to an extensive number of tests and targeted interventions (isolating cases and their contacts), Australia identified and dealt with only 12 cases of Covid-19 (Australian Government Department of Health, 2020). In early March 2020, the government expanded travel restrictions to countries with a large number of cases such as Iran, Italy and South Korea (Price et al., 2020). Despite the aforementioned measures, the number of cases has increased. Since March 16th, 2020 the Australian Government has progressively implemented a series of social distancing measures in order to reduce and prevent further transmission of coronavirus in the community (Prime Minister of Australia, 2020a). The previous day (March 15th) authorities had imposed self-quarantine on all international arrivals.

On March 19th, Australia closed its borders to all non-Australian citizens and non-residents and on March 27th it adopted a mandatory quarantine policy for any citizens and residents who were returning to the country. By March 29th, social distancing measures had escalated to the extent that all Australians were advised to leave their homes only for limited essential activities and public gatherings were limited to two people. By the end of March, the daily counts of new cases appeared to be decreasing, suggesting that these measures had successfully reduced transmission (Prime Minister of Australia, 2020a, 2020b, 2020c, 2020d). The effectiveness of the measures was also reflected by the analysis of the number of proliferation (R) and its decline, as well as the gradual large reduction of the rate of imported cases that contributed to the transmission of the coronavirus (Price et al., 2020).

New Zealand

The first confirmed case in the country was recorded on February 28th, 2020 (World Health Organization, 2021c) and on March 23rd New Zealand launched a series of coronavirus containment and eradication measures. A few days later, the Prime Minister of the country, Jacinda Ardern, announced a strict lockdown, when at that time the country was recording only 102 cases and zero deaths. This rapid decision-making and the immediate reaction gained international recognition, including the WHO (Cousins, 2020). The decision for a lockdown was also supported by academics. According to their announcements, the full lockdown, which resulted in the closure of schools and non-essential workplaces, the prohibition of social gatherings and strict travel restrictions, allowed the country to eliminate the coronavirus, although the measures were very harsh (Cousins, 2020; Baker et al., 2020; Summers et al., 2020; Robert, 2020; Varghese & Xu, 2020). More particularly, the measures included: border check, isolation of travelers from abroad, systematic testing, tracing and epidemiological surveillance. Also a ban on arrivals from certain areas was introduced, followed by an extension of the ban to all arrivals and a ban on the entry of cruise ships, isolation or quarantine of incoming travelers for 14 days and mandatory laboratory testing for Covid-19 on the 3rd and 12th day for those in isolation. With regard to community quarantine, it was decided to cancel public events, to limit gatherings, to close workplaces, to implement a stay-at-home policy and to restrict domestic movements and public transport for the main workers only. School units also closed. With regard to the epidemiological surveillance, extensive contact tracing, community testing of people with respiratory symptoms, screening of asymptomatic individuals in selected population groups and workplaces has been implemented. It has also been decided to extend the controls to specific vulnerable population groups, such as elderly people living in accommodation centers, as well as health professionals (Cousins, 2020; Baker et al., 2020; Summers et al., 2020; Robert, 2020).

The presentation policy of the measures to the citizens of the country has played a very important role in tackling the pandemic. According to Siouxsie Wiles, associate professor at Auckland University, while in other countries people were talking about war and battle, which causes negativism and fearful thinking to citizens, in New Zealand the official reaction was guided by the principle that nobody is stigmatized and all citizens were united against Covid-19 (Cousins, 2020). The value of using the right language and communication approach was recognized as a basic prerequisite for future measures and 83% of citizens agree that the government is trustworthy. Also very high levels of trust were shown by citizens and epidemiologists amid the pandemic, as 85% said that epidemiologists and public health scientists are working in favor of the public interest (Goldfinch et al., 2021).

Singapore

The first confirmed case in the country was recorded on January 24th, 2020 (World Health Organization, 2021d). Upon the diagnosis of the first confirmed laboratory case of Covid-19, a number of public health measures, which escalated in intensity, were immediately put into effect in Singapore. These measures included: strict and systematic tracing of contacts of confirmed cases and isolation of all close contacts of confirmed cases (close contact was defined as a prolonged contact up to 2 meters away of a person who has been confirmed positive) (Kuguyo et al., 2020; Jia & Lu, 2020). With regard to travel, travel instructions were issued, restrictions on entering the country for persons who had travelled to Hubei Province in China were applied and as of January 31st, 2020 entry into the country was restricted to those who had traveled anywhere in China in the previous 14 days. It is estimated that around 700 travelers who had recently travelled to Hubei were placed in isolation, while citizens of Singapore, as well as visa holders, who returned from a trip to China were put on compulsory leave of absence from work for a period of 14 days. Two negative molecular tests (RT-PCR), with a difference of 2 days were necessary to be presented for the isolation to expire (Wong et al., 2020). To support the tracing process, all public hospitals in the country were allowed to carry out SARS-CoV-2 RT-PCR tests (Lee et al., 2020; Lee et al., 2020). A network of more than 800 public health preparedness clinics was developed and activated

immediately in order to improve the management of respiratory infections on Primary Care. As Covid-19 disease at first may be mild and undifferentiated from other respiratory infections, physicians were allowed to give medical permission for up to 5 days to patients with respiratory symptoms. This had a significant positive effect as it allowed possible cases of Covid-19 to be isolated at home and reduced the number of undetected cases that would likely cause dispersion in the community (Lee et al., 2020). Community-level approach in Singapore focused on social responsibility, while life continued as usual with precautions. Public education of citizens has been judged as a key strategy for empowering the public and has been carried out through traditional media (print and electronic) as well as social networks (social media). This strategy included messages about the regular washing of hands, seeking early medical treatment and staying at home when a citizen was feeling unwell. The use of masks was initially encouraged only for sick people to prevent them from infecting others and the government administered 4 masks to each household. In the workplace, workers were encouraged to regularly monitor their temperature and health and businesses allowed their employees to work from home (Lee et al., 2020; Kuguyo et al., 2020). Advice was also given to avoid large scale events (>1000 people). Schools remained open and implemented preventive measures such as the reduction of gatherings, the reduction of class-to-class and inter-school activities and incremental lunch hours. Mass fever control through temperature scanners was widely established in local entrance buildings such as offices, hotels, public centers and places of worship. Despite the numerous precautions, Singapore maintained its daily lifestyle. Singapore had not implemented school closures or other important social distancing measures as there were no signs of widespread community transmission because the COVID-19 infection rates among children remained low (Htun et al., 2020; Jia & Lu, 2020; Kuguyo et al., 2020; Tan et al., 2020).

The Government of Singapore made an effort to control and contain the pandemic which involved the very successful use of technology, namely the use of apps of mobile telephony (A Singapore Government Agency Website, 2021; Ferretti et al.,

2020). The users of digital detection downloaded and installed the applications on their mobile and upon the activation of Bluetooth they received updates when people who had tested positive for Covid-19 were nearby (Budd et al., 2020). Although two thirds of the population of Singapore is not very interested in politics, they showed confidence in their government during the pandemic. This has certainly contributed to their compliance and the implementation of public health protection measures (IPSOS, 2021; The Straits Times, 2020).

Finland

The first confirmed case in the country was recorded on January 28th, 2020 (World Health Organization, 2021b). Much of Finland's response to the beginning of the Covid-19 pandemic has been the implementation of the provisions of the Infectious Disease Act. The government later took stricter measures to stop the spread of the pandemic. Regarding the impact of health policy and interventions in Finland, it is estimated that the incidence of Covid-19 decreased by 13% with the implementation of social distancing measures by citizens. No additional benefits from the closure of public transport were found when four other measures were already in place (closure of school and working places, restrictions on mass gatherings and lockdown) (Tiirinki et al., 2020). The Ministry of Health and Labor issued directives and provided ongoing information regarding social distancing, hand hygiene and the use of personal protective equipment. Testing and case tracing was a key strategy to eliminate the pandemic while easing restrictive measures. Public health measures were the responsibility of local and regional authorities, with citizens showed great confidence in their government (Deutsche Welle, 2020). Priority was given to testing older people and health professionals, as well as the use of electronic tracing applications which inform users of the presence of people positive to the coronavirus. The use of these applications was highly welcomed by citizens (Willberg et al., 2021). In particular, the measures taken by the Finnish Government included the protection of the elderly, with people over 70 years of age abstaining from contact with others as much as possible (quarantine conditions). The use of face

masks was voluntary for the public, who was strongly advised not to spend unnecessary time in public places. Citizens who had been exposed to a positive person were quarantined for two weeks. Upon return from a trip abroad, self-quarantine was recommended. Private and public sector employees were told to work from home, if their duties allowed it. Sports facilities, museums, libraries, swimming pools, youth clubs, day-care centers for the elderly, rehabilitation facilities and laboratories closed down. Visits to accommodation services for the elderly and other high-risk groups were prohibited. The facilities of all educational institutions closed since March 18th.

The implementation of quarantine, social distancing and school closures have had a beneficial effect on reducing the visits of children to emergency departments due to respiratory infections (Kuitunen et al., 2020). The use of face masks was voluntary for the public. Travelers were self-quarantined after a trip abroad to high and moderate risk countries. Public events and gatherings with more than 50 people were prohibited until the beginning of June. Finally, the self-test measure was implemented (Deutsche Welle, 2020; Farooq et al., 2021; Financial Times, 2020; Kabiraj & Lestan, 2020; The BMJ, 2020; Tiirinki et al., 2020; Willberg et al., 2021). The government's immediate response to the containment and quarantine measures, border controls at the country's borders, as well as the citizens' compliance with the government's recommendations have led Finland to implement one of the best health policies in the management of the coronavirus pandemic. Finns are showing a high degree of trust in their government, with the percentage of citizens reaching 80.9%, placing Finland in third highest among the OECD countries (Organisation for Economic Co-operation and Development, 2020).

Iceland

The first confirmed case in the country was recorded on February 29th, 2020 (World Health Organization, 2020). The Icelandic government's response to Covid-19 focused on allowing the relevant experts to convey important information directly to the public. Politicians followed scientific advice from the beginning of the global epidemic until today. This resulted in a high level of preparedness before the coronavirus pandemic reached Iceland. Unlike many countries, Iceland never imposed lockdown and primary schools and kindergartens did not close. In particular, according to the measures, the maximum number of people allowed at the same site was 50. The limitations on the number of people did not apply to public transportation, coach travel, domestic flights, passenger ships and the protective units such as the police, firefighters, civil protection and health care workers. In all workplaces and other activities, it was established that a distance of 2 meters should be ensured between people who were not closely connected. Masks should be worn where the 2 meters social distance rule could not be maintained between individuals. The obligation to use masks did not apply to children born in 2005 or later. The use of masks was implemented when a distance limit of 2 meters could not be guaranteed, such as in health services, domestic flights and ships, public transport, taxis, coaches, hairdressers, etc. The people who were already infected with COVID-19 and had completed the isolation were exempted from the use of masks. The maximum number of people who may be present during religious ceremonies and other social events, cultural and sporting events and conferences was set up to 150. Cultural activities such as theatres and cinemas could accommodate up to 150 people, but the use of mask was mandatory (The Directorate of Health and The Department of Civil Protection and Emergency Management, 2021). However, the most important role in controlling and limiting the transmission of the coronavirus was the identification and tracking of positive citizens. With the help of the biotechnology company deCODE, the authorities examined a large percentage of the population, which facilitated the identification of those who may be infected (Scudellari, 2020). Within nine months, half the population of Iceland was controlled. Of course, the small population of Iceland helped as well. During the screening and detection of cases, a significant proportion of cases were found to be asymptomatic, which highlights the important role of tracing and early diagnosis in isolating the infected, to eliminate contagion. Iceland also successfully put in place mobile phone applications to track positive cases, as reported in the public health policies of aforementioned

countries. It is estimated that about half the population of the country used this tracing application (INSIDER, 2020; MIT Technology Review, 2020; Whitelaw et al., 2020).

Conclusions

The rapid transmission of the coronavirus, combined with a lack of knowledge about the nature of the virus and the disease it causes, brought all countries against the largest pandemic of the modern era. Some countries have reacted quickly by taking social distancing measures, implementing quarantine measures, controlling the country's entrances, testing and tracing and utilized modern smart phone technology. The response of the governments, the adoption and implementation of all measures by the citizens, combined with the organization of health systems, resulted in better management of the pandemic in the countries under study. These measures have undoubtedly been important public health policies, which are a testament to future responses to such pandemics.

Table 1. Demographic profiles.

Countries	Average OECD	Australia	New Zealand	Singapore	Finland	Iceland
Population (Millions)		25,687,041	5,084,300	5,685,807	5,530,719	366,425
GDP per capita (current US$)	45,181	57,137	44,025	59,797	50,638	53,719
Population density (people per sq. km of land area)	38.60	3	19	8,019	18	4
Population ages 65 and above (% of total population)	17.3	15.9	15.3	13	21.8	14.1
Life expectancy at birth, total (years)	81	83	82	83	82	83

Table 2. Health system, expenditure and healthcare resources.

Countries	Average OECD	Australia	New Zealand	Singapore	Finland	Iceland
Health Care System Profile		Public Based on Taxation	Public Based on Taxation	Mixed System	Public Based on Taxation	Public Based on Taxation
Current health expenditure (% of GDP)	8.8	9.28	9.21	4.46	9.04	8.47
Out-of-pocket expenditure (% of current health expenditure)	20	17.72	12.91	31.04	18.43	15.95
Practising nurses per 1,000 population	8.8	11.7	10.2	7.5	14.3	14.5
Practising doctors per 1,000 population	3.6	3.7	3.3	2.5	3.2	3.9

Table 3. Health Behaviors and prevalence of Chronic Conditions.

Countries	Australia	New Zealand	Singapore	Finland	Iceland
Overweight including obesity among adults	65.2	66.6	36.2	67.6	65.4
Diabetes prevalence among adults	5.1	8.1	5.5	5.8	5.3
Adult population smoking daily	12.4	13.8	13.0	14.0	8.6

Table 4. COVID-19 Indicators.

Countries	Australia[a]	New Zealand[b]	Singapore[c]	Finland[d]	Iceland[e]
Case Fatality Rate	3.04%	0.98%	0.05%	1.04%	0.44%
COVID-19 cases/100,000 population	117.02	47.36	1,048.33	1,598.68	1,790.28
COVID-19 Deaths/100,000 population	3.57	0.54	0.53	16.69	7.96

[a] until May 4th, 2021 [b] until May 8th, 2021   [c] until May 9th, 2021   [d] until May 10th, 2021 [e] until May 11th, 2021

References

2019-nCoV National Incident Room Surveillance Team. (2020). 2019-nCoV acute respiratory disease, Australia Epidemiology Report 1 Reporting week 26 January – 1 February 2020 2019-nCoV National Incident Room Surveillance Team. *Communicable Diseases Intelligence*, *44*. 13

A Singapore Government Agency Website. (2021). *TraceTogether*. https://www.tracetogether.gov.sg/

Almagor, J., & Picascia, S. (2020). Exploring the effectiveness of a COVID-19 contact tracing app using an agent-based model. *Scientific Reports*, *10*(1), 1–11.

Australia Bureau of Statistics. (2021, February). *Overseas Arrivals and Departures, Australia, February 2021 | Australian Bureau of Statistics*. https://www.abs.gov.au/statistics/industry/tourism-and-transport/overseas-arrivals-and-departures-australia/latest-release

Australian Government Department of Health. (2020, January 30). *Australian Health Protection Principal Committee (AHPPC) statement on novel coronavirus on 29 January 2020 | .* https://www.health.gov.au/news/australian-health-protection-principal-committee-ahppc-statement-on-novel-coronavirus-on-29-january-2020-0

Baker, M. G., Wilson, N., & Anglemyer, A. (2020). Successful Elimination of Covid-19 Transmission in New Zealand. *New England Journal of Medicine*, *383*(8), e56.

Budd, J., Miller, B. S., Manning, E. M., Lampos, V., Zhuang, M., Edelstein, M., Rees, G., Emery, V. C., Stevens, M. M., Keegan, N., Short, M. J., Pillay, D., Manley, E., Cox, I. J., Heymann, D., Johnson, A. M., & McKendry, R. A. (2020). Digital technologies in the public-health response to COVID-19. In *Nature Medicine* (Vol. 26, Issue 8, pp. 1183–1192). Nature Research.

Chen, T., Wu, D., Chen, H., Yan, W., Yang, D., Chen, G., Ma, K., Xu, D., Yu, H., Wang, H., Wang, T., Guo, W., Chen, J., Ding, C., Zhang, X., Huang, J., Han, M., Li, S., Luo, X., … Ning, Q. (2020). Clinical characteristics of 113 deceased patients with coronavirus disease 2019: Retrospective study. *The BMJ*, *368*.

Chinazzi, M., Davis, J. T., Ajelli, M., Gioannini, C., Litvinova, M., Merler, S., Pastore y Piontti, A., Mu, K., Rossi, L., Sun, K., Viboud, C., Xiong, X., Yu, H., Elizabeth Halloran, M., Longini, I. M., & Vespignani, A. (2020). The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. *Science*, *368*(6489), 395–400.

Cousins, S. (2020). New Zealand eliminates COVID-19. *The Lancet*, *395*(10235), 1474.

Cronin, C., & Evans, W. (2020). Private Precaution and Public Restrictions: What Drives Social Distancing and Industry Foot Traffic in the COVID-19 Era? *National Bureau of Economic Research*.

Deutsche Welle. (2020). *Why is Finland coping so well with the coronavirus crisis? | Europe| News and current affairs from around the continent* . Why Is Finland Coping so Well with the Coronavirus Crisis? https://www.dw.com/en/coronavirus-finland-sweden-role-model/a-55664117

Esai Selvan, M. (2020). Risk factors for death from COVID-19. *Nature Reviews Immunology*, *20*(7), 407.

Farooq, A., Laato, S., Islam, A. K. M. N., & Isoaho, J. (2021). Understanding the impact of information sources on COVID-19 related preventive measures in Finland. *Technology in Society*, *65*, 101573.

Ferretti, L., Wymant, C., Kendall, M., Zhao, L., Nurtay, A., Abeler-Dörner, L., Parker, M., Bonsall, D., & Fraser, C. (2020). Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing. *Science*, *368*(6491).

Financial Times. (2020). *How Finland kept Covid in check* . https://www.ft.com/content/61dccfaa-0871-48a2-80ac-dbe6d5b5b5f8

Giannouchos, T. V., Sussman, R. A., Mier, J. M., Poulas, K., & Farsalinos, K. (2020). Characteristics and risk factors for COVID-19 diagnosis and adverse outcomes in Mexico: an analysis of 89,756 laboratory–confirmed COVID-19 cases. *European Respiratory Journal*, 2002144.

Girum, T., Lentiro, K., Geremew, M., Migora, B., & Shewamare, S. (2020). Global strategies and effectiveness for COVID-19 prevention through contact tracing, screening, quarantine, and isolation: a systematic review. *Tropical Medicine and Health 2020 48:1*, *48*(1), 1–15.

Goldfinch, S., Taplin, R., & Gauld, R. (2021). Trust in government increased during the Covid-19 pandemic in Australia and New Zealand. *Australian Journal of Public Administration*, *80*(1):3–11.

Hernández-Orallo, E., Calafate, C. T., Cano, J.-C., & Manzoni, P. (2020). Evaluating the Effectiveness of COVID-19 Bluetooth-Based Smartphone Contact Tracing Applications. *Applied Sciences*, *10*(20), 7113.

Htun, H. L., Lim, D. W., Kyaw, W. M., Loh, W.-N. J., Lee, L. T., Ang, B., & Chow, A. (2020). Responding to the COVID-19 Outbreak in Singapore: Staff Protection and Staff Temperature and Sickness Surveillance Systems. *Clinical Infectious Diseases*, *71*(8), 1947–1952.

Iftimie, S., López-Azcona, A. F., Vallverdú, I., Hernández-Flix, S., de Febrer, G., Parra, S., Hernández-Aguilera, A., Riu, F., Joven, J., Andreychuk, N., Baiges-Gaya, G., Ballester, F., Benavent, M., Burdeos, J., Català, A., Castañé, È.,

Castañé, H., Colom, J., Feliu, M., … Castro, A. (2021). First and second waves of coronavirus disease-19: A comparative study in hospitalized patients in Reus, Spain. *PLOS ONE, 16*(3), e0248029.

INSIDER. (2020, May 12). *Iceland's Contact-Tracing App Is the Most Successful Downloads-Wise, but It's Not a Gamechanger.* https://www.businessinsider.com/iceland-contact-tracing-not-gamechanger-2020-5

IPSOS. (2021). *Singaporeans are confident in the Government amidst fears of the COVID-19 outbreak | Ipsos.* https://www.ipsos.com/en-sg/singaporeans-are-confident-government-amidst-fears-covid-19-outbreak

Jia, Z., & Lu, Z. (2020). The important role of serology for COVID-19 control. *The Lancet Infectious Diseases, 20*, 758–759.

Johns Hopkins Coronavirus Resource Center. (2021a). *COVID-19 Map - Finland.* Finland. https://coronavirus.jhu.edu/map.html

Johns Hopkins Coronavirus Resource Center. (2021b). *COVID-19 Map - Johns Hopkins Coronavirus Resource Center.* COVID-19 Dashboard. https://coronavirus.jhu.edu/map.html

Johns Hopkins University and Medicine. (2021). *COVID-19 Map - Johns Hopkins Coronavirus Resource Center.* https://coronavirus.jhu.edu/map.html

Kabiraj, S., & Lestan, F. (2020). COVID-19 Outbreak in Finland: Case Study on the Management of Pandemics. In *International Case Studies in the Management of Disasters* (pp. 213–229). Emerald Publishing Limited. https://doi.org/10.1108/978-1-83982-186-820201013

Killerby, M. E., Link-Gelles, R., Haight, S. C., Schrodt, C. A., England, L., Gomes, D. J., Shamout, M., Pettrone, K., O'Laughlin, K., Kimball, A., Blau, E. F., Burnett, E., Ladva, C. N., Szablewski, C. M., Tobin-D'Angelo, M., Oosmanally, N., Drenzek, C., Murphy, D. J., Blum, J. M., Wong, K. K. (2020). Characteristics Associated with Hospitalization Among Patients with COVID-19 — Metropolitan Atlanta, Georgia, March–April 2020. *MMWR. Morbidity and Mortality Weekly Report, 69*(25), 790–794.

Kleinman, R. A., & Merkel, C. (2020). Digital contact tracing for COVID-19. *CMAJ, 192*(24), E653–E656.

Kraemer, M. U. G., Yang, C. H., Gutierrez, B., Wu, C. H., Klein, B., Pigott, D. M., du Plessis, L., Faria, N. R., Li, R., Hanage, W. P., Brownstein, J. S., Layan, M., Vespignani, A., Tian, H., Dye, C., Pybus, O. G., & Scarpino, S. V. (2020). The effect of human mobility and control measures on the COVID-19 epidemic in China. *Science, 368*(6490), 493–497.

Kuguyo, O., Kengne, A. P., & Dandara, C. (2020). Singapore COVID-19 Pandemic Response as a Successful Model Framework for Low-Resource Health Care Settings in Africa? *OMICS: A Journal of Integrative Biology, 24*(8), 470–478.

Kuitunen, I., Artama, M., Mäkelä, L., Backman, K., Heiskanen-Kosma, T., & Renko, M. (2020). Effect of Social Distancing Due to the COVID-19 Pandemic on the Incidence of Viral Respiratory Tract Infections in Children in Finland during Early 2020. *Pediatric Infectious Disease Journal*, E423–E427.

Lee, V. J., Chiew, C. J., & Khong, W. X. (2020). Interrupting transmission of COVID-19: lessons from containment efforts in Singapore. *Journal of Travel Medicine, 27*(3), 1–5.

Levin, A. T., Hanage, W. P., Owusu-Boaitey, N., Cochran, K. B., Walsh, S. P., & Meyerowitz-Katz, G. (2020). Assessing the age specificity of infection fatality rates for COVID-19: systematic review, meta-analysis, and public policy implications. *European Journal of Epidemiology 2020 35:12, 35*(12), 1123–1138.

Lewis, T. (2021, March 11). *How the U.S. Pandemic Response Went Wrong--and What Went Right--during a Year of COVID - Scientific American.* https://www.scientificamerican.com/article/how-the-u-s-pandemic-response-went-wrong-and-what-went-right-during-a-year-of-covid/

Med Sci, T. J., Güner, R., Hasanoğlu, İ., & Aktaş, F. (2020). Turkish Journal of Medical Sciences COVID-19: Prevention and control measures in community. *TURKISH JOURNAL OF MEDICAL SCIENCES, 50*(SI-1), 571–577.

MIT Technology Review. (2020, May 11). *Nearly 40% of Icelanders are using a covid app—and it hasn't helped much | MIT Technology Review.* https://www.technologyreview.com/2020/05/11/1001541/iceland-rakning-c19-covid-contact-tracing/

OECD. (2019). OECD Health at a Glance. In *OECD iLibrary* (Health at a Glance). OECD. https://doi.org/10.1787/4dd50c09-en

OECD. (2020). *GDP and spending - Gross domestic product (GDP) - OECD Data.* https://data.oecd.org/gdp/gross-domestic-product-gdp.htm

OECD. (2021). *Health at a Glance 2021 OECD INDICATORS.* https://www.oecd-ilibrary.org/docserver/ae3016b9-en.pdf?expires=1637171509&id=id&accname=guest&checksum=F5EC5E2B30227D50CD166A0693DF5814

Organisation for Economic Co-operation and Development. (2020). *General government - Trust in government.* https://data.oecd.org/gga/trust-in-government.htm

Price-Haywood, E. G., Burton, J., Fort, D., & Seoane, L. (2020). Hospitalization and Mortality among Black Patients and White Patients with Covid-19. *New England Journal of Medicine, 382*(26),

2534–2543.

Price, D. J., Shearer, F. M., Meehan, M. T., McBryde, E., Moss, R., Golding, N., Conway, E. J., Dawson, P., Cromer, D., Wood, J., Abbott, S., McVernon, J., & McCaw, J. M. (2020). Early analysis of the australian covid-19 epidemic. *ELife*, *9*, 1–14.

Prime Minister of Australia. (2020a, March 13). *Advice on coronavirus*. MEDIA RELEASE. https://www.pm.gov.au/media/advice-coronavirus

Prime Minister of Australia. (2020b, March 19). *Border Restrictions*. MEDIA RELEASE. https://www.pm.gov.au/media/border-restrictions

Prime Minister of Australia. (2020c, March 27). *Update on coronavirus measures*. MEDIA RELEASE. https://www.pm.gov.au/media/update-coronavirus-measures-270320

Prime Minister of Australia. (2020d, March 30). *Statement - Update on Coronavirus Measures*. MEDIA STATEMENT. https://www.pm.gov.au/media/statement-update-coronavirus-measures

Richardson, S., Hirsch, J. S., Narasimhan, M., Crawford, J. M., McGinn, T., Davidson, K. W., Barnaby, D. P., Becker, L. B., Chelico, J. D., Cohen, S. L., Cookingham, J., Coppa, K., Diefenbach, M. A., Dominello, A. J., Duer-Hefele, J., Falzon, L., Gitlin, J., Hajizadeh, N., Harvin, T. G., … Zanos, T. P. (2020). Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area. *JAMA*, *323*(20), 2052–2059. https://doi.org/10.1001/jama.2020.6775

Robert, A. (2020). Lessons from New Zealand's COVID-19 outbreak response. In *The Lancet Public Health* (Vol. 5, Issue 11, pp. e569–e570).

ScienceDirect Topics. (2007). *Case Fatality Rate - an overview*. https://www.sciencedirect.com/topics/medicine-and-dentistry/case-fatality-rate

Scudellari, M. (2020). How Iceland hammered COVID with science. *Nature*, *587*(7835), 536–539.

Shearer, F. M., Walker, J., Tellioglu, N., McCaw, J. M., McVernon, J., Black, A., & Geard, N. (2020). Assessing the risk of spread of COVID-19 to the Asia Pacific region. In *medRxiv* (p. 2020.04.09.20057257). medRxiv.

Singapore at a glance. (2021). *Healthcare Professional to Population Ratio*. https://data.gov.sg/dataset/healthcare-professional-to-population-ratio

Summers, D. J., Cheng, D. H.-Y., Lin, P. H.-H., Barnard, D. L. T., Kvalsvig, D. A., Wilson, P. N., & Baker, P. M. G. (2020). Potential lessons from the Taiwan and New Zealand health responses to the COVID-19 pandemic. *The Lancet Regional Health - Western Pacific*, *4*, 100044.

Tan, T. H. Y., Toh, M. P. H. S., Vasoo, S., Lye, D. C.

B., Ang, B. S. P., Leo, Y. S., Lee, V. J. M., Puah, S. H., & Kurup, A. (2020). Coronavirus Disease 2019 (COVID-19): The Singapore Experience. A Review of the First Eight Months. In *Annals of the Academy of Medicine, Singapore* (Vol. 49, Issue 10, pp. 764–778). NLM (Medline).

The BMJ. (2020, September). *Covid-19: what can we learn from Finland's experience of the pandemic?*. https://blogs.bmj.com/bmj/2020/09/04/covid-19-what-can-we-learn-from-finlands-experience-of-the-pandemic/

The Commonwealth Fund. (2021). *International Health Care System Profiles*. https://www.commonwealthfund.org/international-health-policy-center/system-profiles

The Directorate of Health and The Department of Civil Protection and Emergency Management. (2021). *Effective restrictions on gatherings*. https://www.covid.is/categories/effective-restrictions-on-gatherings

The Straits Times. (2020). *Singaporeans have high level of confidence in Government but politically uninterested: IPS study, Politics News & Top Stories - The Straits Times*. https://www.straitstimes.com/singapore/politics/singaporeans-have-high-level-of-confidence-in-government-but-politically

The World bank. (2021). *Current health expenditure (% of GDP)*. https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS

The World Bank. (2021a). *Diabetes prevalence (% of population ages 20 to 79)*. https://data.worldbank.org/indicator/SH.STA.DIAB.ZS?locations=SG

The World Bank. (2021b). *GDP per capita (current US$)*. https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

The World Bank. (2021c). *Life expectancy at birth, total (years)*. https://data.worldbank.org/indicator/SP.DYN.LE00.IN

The World Bank. (2021d). *Out-of-pocket expenditure (% of current health expenditure)*. https://data.worldbank.org/indicator/SH.XPD.OOPC.CH.ZS

The World Bank. (2021e). *Population, total - OECD members*. https://data.worldbank.org/indicator/SP.POP.TOTL?locations=OE

The World Bank. (2021f). *Population ages 65 and above (% of total population)*. https://data.worldbank.org/indicator/SP.POP.65UP.TO.ZS?locations=SG

The World Bank. (2021g). *Population density (people per sq. km of land area) - OECD members | Data*. https://data.worldbank.org/indicator/EN.POP.DNST?locations=OE

The World Bank. (2021h). *Population density (people per sq. km of land area)* . https://data.worldbank.org/indicator/EN.POP.DNST

Tian, H., Liu, Y., Li, Y., Wu, C. H., Chen, B., Kraemer, M. U. G., Li, B., Cai, J., Xu, B., Yang, Q., Wang, B., Yang, P., Cui, Y., Song, Y., Zheng, P., Wang, Q., Bjornstad, O. N., Yang, R., Grenfell, B. T., Dye, C. (2020). An investigation of transmission control measures during the first 50 days of the COVID-19 epidemic in China. *Science*, *368*(6491), 638–642.

Tiirinki, H., Tynkkynen, L. K., Sovala, M., Atkins, S., Koivusalo, M., Rautiainen, P., Jormanainen, V., & Keskimäki, I. (2020). COVID-19 pandemic in Finland – Preliminary analysis on health system response and economic consequences. *Health Policy and Technology*, *9*(4), 649–662.

University of Oxford. (2021). *Coronavirus (COVID-19) Cases - Statistics and Research - Our World in Data*. Daily New Confirmed COVID-19 Cases per Million People. https://ourworldindata.org/covid-cases

Varghese, C., & Xu, W. (2020). Quantifying what could have been – The impact of the Australian and New Zealand governments' response to COVID-19. In *Infection, Disease and Health* (Vol. 25, Issue 4, pp. 242–244). Australasian College for Infection Prevention and Control.

Whitelaw, S., Mamas, M. A., Topol, E., & Van Spall, H. G. C. (2020). Applications of digital technology in COVID-19 pandemic planning and response. In *The Lancet Digital Health* (Vol. 2, Issue 8, pp. e435–e440). Elsevier Ltd. https://doi.org/10.1016/S2589-7500(20)30142-4

WHO. (2020, March). *Media Statement: Knowing the risks for COVID-19*. Media Statement: Knowing the Risks for COVID-19. https://www.who.int/indonesia/news/detail/08-03-2020-knowing-the-risk-for-covid-19

Willberg, E., Järv, O., Väisänen, T., & Toivonen, T. (2021). Escaping from Cities during the COVID-19 Crisis: Using Mobile Phone Data to Trace Mobility in Finland. *ISPRS International Journal of Geo-Information*, *10*(2), 103.

Wong, J. E. L., Leo, Y. S., & Tan, C. C. (2020). COVID-19 in Singapore - Current Experience: Critical Global Issues That Require Attention and Action. In *JAMA - Journal of the American Medical Association* (Vol. 323, Issue 13, pp. 1243–1244). American Medical Association.

World Bank. (2021). *Prevalence of current tobacco use (% of adults) - Singapore | Data*. https://data.worldbank.org/indicator/SH.PRV.SMOK?locations=SG

World Health Organization. (2020). *Coronavirus disease (COVID-19)*. Coronavirus Disease (COVID-19). https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19

World Health Organization. (2021a). *Australia: WHO Coronavirus Disease (COVID-19) Dashboard*. WHO Coronavirus (COVID-19) Dashboard. https://covid19.who.int/region/wpro/country/au

World Health Organization. (2021b). *Finland: WHO Coronavirus Disease (COVID-19) Dashboard*. WHO Coronavirus (COVID-19) Dashboard. https://covid19.who.int/region/euro/country/fi

World Health Organization. (2021c). *New Zealand: WHO Coronavirus Disease (COVID-19) Dashboard*. WHO Coronavirus (COVID-19) Dashboard. https://covid19.who.int/region/wpro/country/nz

World Health Organization. (2021d). *Singapore: WHO Coronavirus Disease (COVID-19) Dashboard*. WHO Coronavirus (COVID-19) Dashboard. https://covid19.who.int/region/wpro/country/sg

World Health Organization. (2021e). *WHO Coronavirus (COVID-19) Dashboard*. WHO Coronavirus (COVID-19) Dashboard. https://covid19.who.int/table

World Health Organization. (2021f, March). *WHO Coronavirus (COVID-19) Dashboard | WHO Coronavirus Disease (COVID-19) Dashboard*. https://covid19.who.int/

World Obesity. (2021). *Singapore | World Obesity Federation Global Obesity Observatory*. https://data.worldobesity.org/country/singapore-192/#data_prevalence

Wu, Z., & McGoogan, J. M. (2020). Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72314 Cases from the Chinese Center for Disease Control and Prevention. In *JAMA - Journal of the American Medical Association* (Vol. 323, Issue 13, pp. 1239–1242). American Medical Association.

Xiao, Y., & Torok, M. E. (2020). Taking the right measures to control COVID-19. In *The Lancet Infectious Diseases* (Vol. 20, Issue 5, pp. 523–524). Lancet Publishing Group.

Yang, J., Zheng, Y., Gou, X., Pu, K., Chen, Z., Guo, Q., Ji, R., Wang, H., Wang, Y., & Zhou, Y. (2020). Prevalence of comorbidities and its effects in coronavirus disease 2019 patients: A systematic review and meta-analysis. *International Journal of Infectious Diseases*, *94*, 91–95.

EODY. New coronavirus Covid-19-Guidelibes-National Organization National Organization of Public Health. https://eody.gov.gr/neos-koronaios-covid-19/