Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Letter to the Editor

Quantifying what could have been – The impact of the Australian and New Zealand governments' response to COVID-19

KEYWORDS
COVID019;
Pandemic;
government;
Bayesian structural time series

Abstract *Background:* The Australian and New Zealand governments both initiated strict social distancing measures in response to the COVID-19 pandemic in late March. It remains difficult to quantify the impact this had in reducing the spread of the virus.
Methods: Bayesian structural time series model provide a model to quantify the scenario in which these government-level interventions were not placed. Our models predict these strict social distancing measures caused a 79% and 61% reduction in the daily cases of COVID-19 across Australia and New Zealand respectively.
Conclusion: This provides both evidence and impetus for governments considering similar measures in response to COVID-19 and other pandemics.

Highlights

- We discuss the government response in Australia and New Zealand to the COVID-19 global pandemic.
- We quantify and visualise the likely daily cases were it not for the government response.
- A Bayesian structural time series model was used to generate the counterfactual, i.e. the 'what-if' scenario.

Introduction

The COVID-19 pandemic has been characterised by a heterogenous response from governments around the world. Some have initiated early social distancing measures and mandatory shut down of non-essential services, while others have relied heavily on thorough test and trace strategies [1]. There have been variations in the severity of government measures between countries. Among this heterogeneity, it is difficult to quantify the effect of these actions and what may have occurred in the absence of such efforts.

On the 25th of March 2020, at 11.59pm, New Zealand entered Alert Level 4 in an attempt to eliminate viral transmission [2]. Alert Level 4 assumes sustained and intensive transmission of COVID-19, making widespread outbreaks likely. The government has implemented a range of urgent measures including: instructing people to stay at home, closure of educational facilities and non-essential facilities (excluding supermarkets, pharmacies, clinics and lifeline utilities), rationing of supplies, requisition of facilities, suspension of international travel, limitation of domestic travel, and major reprioritisation of healthcare

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services. Australia mounted a similar but slightly less stringent nationwide response on the 29th of March [3]. Widespread social distancing measures were implemented with varying levels of non-essential facility shutdown between country states.

We aimed to investigate the effect of government driven social distancing measures in Australia and New Zealand and quantify the potential magnitude of COVID-19 case reduction.

Methods

In the absence of randomized controlled data investigating the impact of quarantine measures at the country-level, causal inferences via Bayesian structural time series models may provide a suitable alternative. Our model was trained on both real-world data and simulated statistics to generate a counterfactual model. The counterfactual was defined as the predicted number of daily cases if strict social distancing measures were not implemented by the New Zealand or Australian government.

A modified SEIR calculator, utilised in other COVID-19 modelling studies [5], was used to estimate the rate of COVID-19 dissemination through the New Zealand and Australian populations [6]. SEIR predictive parameters inputted into the model were: a population of 4.88 million and 24.99 million (current New Zealand and Australia population respectively), a reproductive number of 3 [7], an incubation period of 5 days [4], an assumed infectious period of 10 days and 1 initial case. The Bayesian model was trained on the pre-period from the 26th of February 2020 to 24th of March 2020 for New Zealand and the 25th of January 2020 to the 28th of March 2020 for Australia. The pre-period represents the time between the first confirmed case of COVID-19 and government measure implementation. Through an iterative process, an estimated projection of new daily cases for the post-period (from 25th of March 2020 for New Zealand and 29th March 2020 for Australia to 12th of April 2020), i.e. the counterfactual, was generated (Fig. 1). Model uncertainty is expressed as 95% credibility intervals.

Results

New Zealand Alert Level 4 measures showed a 61% reduction in daily COVID-19 confirmed cases on the 12th of April 2020 (95% credibility interval: −82% to −43%, P = 0.001) when compared to the counterfactual. Observed cases in the post-period show an average daily case count of 58 and cumulative case count of 1104 over the total duration. This increased to an average daily case count of 148 (SD 15) and cumulative count of 2821 (SD 277) in the counterfactual. This corresponds to an absolute reduction of average daily cases of 90 (SD 15; 95% CI -120—63) and an absolute reduction in cumulative cases of 1717 (SD 277; 95% CI -2289—1190). This shows a statistically significant effect between the government's mandatory social-distancing intervention and the reduction of COVID-19 cases in New Zealand.

Strict social distancing measures from the Australian government showed a 79% reduction in daily COVID-19 confirmed cases on the 12th of April 2020 (95% credibility interval: −95% to −64%, P = 0.001) when compared to the counterfactual. Observed cases in the post-period show an average daily case count of 204 and cumulative case count of 2860 over the total duration. This increased to an average daily case count of 972 (SD 78) and cumulative count of 13,609 (SD 1089) in the counterfactual. This corresponds to an absolute reduction of average daily cases of 768 (SD 78; 95% CI -928 to −621) and an absolute reduction in cumulative cases of 10,749 (SD 277; 95% CI -12,987—8689). Again, the Australian government's measures show a statistically significant reduction of COVID-19 cases. There was no statistically significant difference in relative case reduction between New Zealand and Australia.

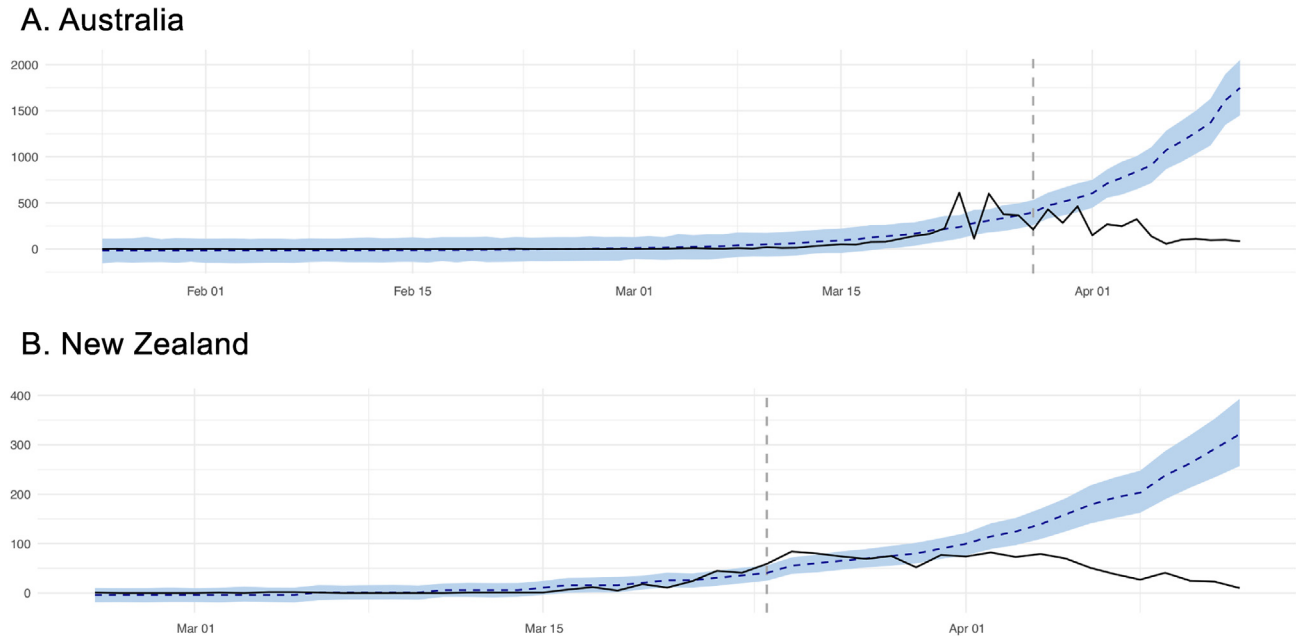

Figure 1 Bayesian structural time series model of the counterfactual (blue), and observed daily cases (black).

Discussion

This analysis is limited due to the assumptions made regarding the incubation period, infectious periods and other characteristics of SARS-CoV-2. These parameters were based on the information available at the time of analysis. Additionally, the observed daily case counts are likely influenced by the extent of testing and the true case load may be higher. While the exact contributions of each government-level action cannot be accounted for, we provide the first quantification of the potential magnitude of case reduction.

Government-driven social distancing measures have reduced COVID-19 spread in both New Zealand and Australia. As far as we are aware, this is the first such counterfactual model that utilises Bayesian causal inference models. The present model provides an impetus for other governments to prioritise rapid government-level responses of social distancing and minimisation of non-essential services. In future pandemics, this serves as a valuable indicator of how early action can minimise disease spread. Concern around the efficacy of these measures should be minimal for governments considering similar quarantine measures.

Ethics

No ethical approval was sought as only publicly available data was used in this analysis.

Authorship statement

CV conceived the idea of the letter. CV conducted statistical analysis. All authors contributed with the first draft. All authors contributed with subsequent revisions. All authors approved the final submitted version.

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