

Interpreting the effect of social restrictions on cases of COVID-19 using mobility data

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Abstract

Social restrictions used in the COVID-19 pandemic remain contentious. Coupling data for confirmed COVID-19 cases with mobility trends offers insight into the efficacy of restrictions in Australia, Sweden and South Korea. Social restrictions have reduced COVID-19 spread. The degree of social restrictions as the pandemic progresses remains a key challenge.

Main Text

Introduction

Social restrictions of varying degree have been implemented throughout the world to reduce the spread of infection. A comparable historic pandemic is the 1918-1919 influenza pandemic. Analysis of the response to the influenza pandemic in the United States response showed that early application of social restrictions reduced mortalities.¹ These restrictions all have all have economic consequences. Coupling published data for confirmed COVID-19 cases with mobility trends in Australia, Sweden and South Korea may offer insight into the efficacy of social restrictions.

Methods

Google COVID-19 Community Mobility Data² was accessed for residential and workplace mobility trends. Mobility trends are based on percentage deviation from a baseline derived from the period January 3rd to February 6th 2020. Prophet software³ was used to determine inflexion points within the residential mobility trend to determine the “Effective Lockdown Date” (ELD) (i.e. time when people began to stay home).

The COVID-19 Dataset at Johns Hopkins University⁴ was transformed to track confirmed cases and then calculate doubling time of confirmed cases using:

Growth rate at day t ,

$$r(t) = \frac{C(t) - C(t-1)}{C(t-1)}$$

Where $C(t)$ is the cumulative number of confirmed cases at day t .

Doubling time at day t ,

$$d(t) = \frac{\ln(2)}{\ln(1 + r(t))}$$

97.5% of COVID-19 patients develop symptoms within 11 days of exposure⁵, hence the effect of ELD was calculated after 14 days to account for delays in incubation and testing. A time series analysis (ITS) was applied at ELD + 14 days to determine the effect of the ELD on doubling time using Stata version 15.1 software.

Results

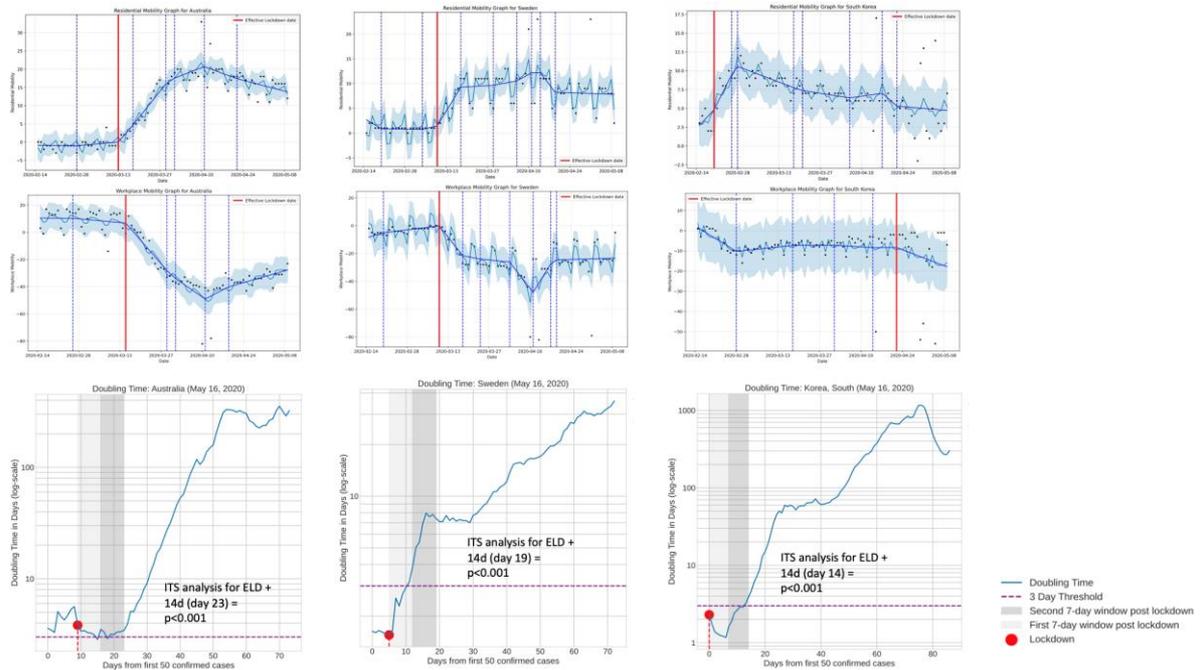


Figure 1. Comparison of mobility trends (% change from baseline) in residential and workplaces (top 2 graphs). Effective Lockdown Date (ELD) from residential graph transposed onto doubling time graph with ITS analysis for Australia, Sweden and South Korea.

Discussion

The estimated Effective Lockdown Date was significantly associated with an increase in doubling time, i.e. slowing of growth, of confirmed cases after an estimated 14-day period. This occurred in all three countries ($p < 0.001$ for each).

There appears to be 3 distinct types of societal reactions to social restrictions suggesting different degrees of economic shutdown; complete ‘effective’ lockdown (Australia), partial ‘effective’ lockdown with degree of workplace activity (Sweden) and minimal ‘effective’ lockdown with degree of workplace and commercial activity (South Korea). The Australian graphs are the most orthodox and, similar to most other countries with lockdowns, feature large amplitude excursions (40-80%), with an axis of symmetry suggesting people are not going to their workplace and are staying at home. Sweden is interesting in that there appears to be preserved symmetry with reduced amplitude of workplace mobility decrement (20-40%) suggesting some degree of workplace activity. South Korea is intriguing as the amplitude is smallest (10%) but there is also a progressive loss of symmetry as time elapses. This mobility deficit is accounted for when considering the retail and recreation mobility data that depicts a trend toward baseline commercial activity, whilst maintaining low rates of new cases.

Early social restrictions clearly reduce the spread of COVID-19. Mobility data may help to guide policy that strikes the balance between social restrictions and new cases of COVID-19.

References

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