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

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Abstract (50 words, limit 50 words)

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

Main Text (499 words excluding Figure 1 footnote, 500 word limit)

Introduction

Social restrictions of varying degree have been implemented throughout the world to reduce the spread of infection during the COVID-19 pandemic. A comparable historic antecedent is the 1918-1919 influenza pandemic. Analysis of the response to the influenza pandemic in the United States showed that early application of social restrictions reduced mortalities.[1] These restrictions 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 Data[2] 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. Automated change point detection using the prophet time series forecasting model[3] 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 University[4] was transformed to track confirmed cases and 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 exposure[5], to account for incubation related symptom lag and testing delays, an interrupted time series analysis (ITS) was applied at ELD + 14 days to determine the effect on doubling time using Stata version 15.1 software. Increases in doubling time is considered favourable.

Both population-based datasets used to generate the data visualisations were free, publicly available and de-identified. Consistent with the Australian National Statement on Ethical Conduct in Human Research 2007 (updated 2018), this study was considered exempt from ethical review.

Results

Figure 1

Discussion

The Effective Lockdown Date was significantly associated with an increase in doubling time, i.e. slowing of growth, of confirmed cases after a 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 lockdown (Australia), partial lockdown with preserved workplace activity (Sweden) and minimal lockdown with preservation of both workplace and commercial activity (South Korea). The Australian graphs are the most orthodox and similar to most other countries with lockdowns, featuring large amplitude excursions (40-80%), with an axis of symmetry suggesting people are not going to their workplaces and staying at home. Sweden is interesting in that there is also symmetry but with reduced workplace mobility decrement (20-40%) suggesting preservation of workplace activity. South Korea is intriguing as the amplitude is not only smallest (10%) but suggests a progressive loss of symmetry as time elapses. This is 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.

Competing interests: No relevant disclosures

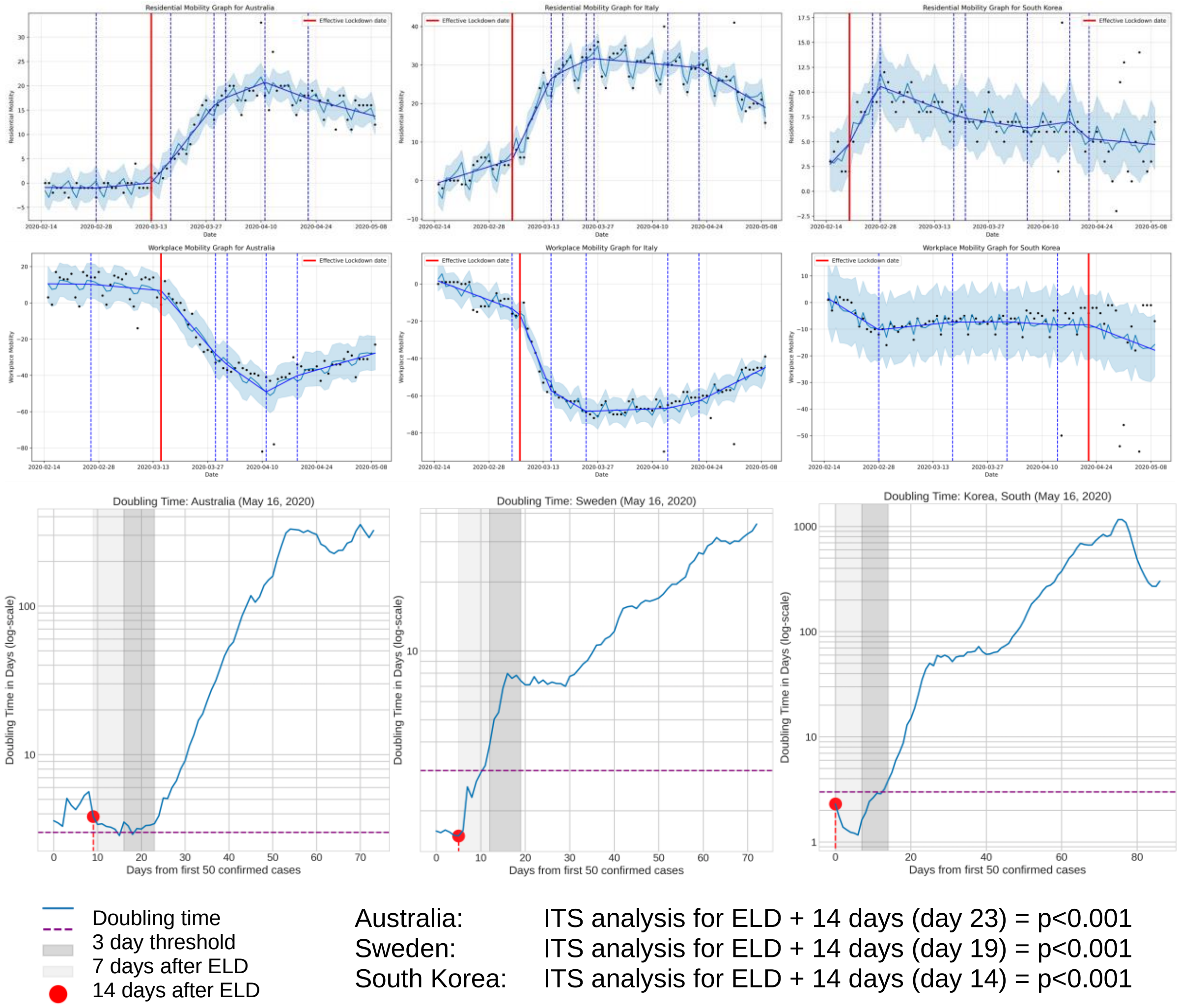

Figure 1. Effect of changes in mobility trends (% change from baseline) on doubling time of COVID 19 cases. Residential mobility (top) and workplace mobility (middle) juxtaposed with doubling time (bottom). ELD from residential graph transposed into doubling time graph (red dot). Effect of ELD calculated via ITS analysis at ELD + 14 days (bottom graph).

References

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