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Effects of Containment and Closure Policies on Controlling the COVID-19 Pandemic in East Asia

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Author Contribution Statement

Sylvia Chen and Ben Lam wrote the first draft of the manuscript. Ben Lam analyzed the data. All authors contributed to the conceptualization and revision of the paper.

Abstract

Growing efforts have been made to pool coronavirus data and control measures from countries and regions to compare the effectiveness of government policies. We examine whether these strategies can explain East Asia's effective control of the COVID-19 pandemic based on time-series data with cross-correlations between the Stringency Index and number of confirmed cases during the early period of outbreaks. We suggest that multidisciplinary empirical research in health care and social sciences, personality and social psychology is needed for a clear understanding of how cultural values, social norms, and individual predispositions interact with policy to affect life-saving behavioral changes in different societies.

Keywords: COVID-19, containment and closure policies, vigilance, civic responsibility, multidisciplinary perspective

Efforts are growing to pool coronavirus data and control measures from countries and regions to build epidemic models and inform government policies (Enserink, & Kupferschmidt, 2020; Gibney, 2020). Modeling and forecasting the spread of the coronavirus diseases 2019 (COVID-19) focus on non-pharmaceutical public health interventions, such as social distancing, shelter in place orders, disease surveillance, contact tracing, isolation, and quarantine (Bertozzi, Franco, Mohler, Short, & Sledge, 2020). Are these interventions effective in preventing the transmission of the COVID-19 pandemic? This concerns collective regulation of individuals' behaviors, a question central to our discipline.

Researchers proposed a biopsychosocial model of behavioral medicine to go beyond a narrow focus on the medical aspects of health and illness and to integrate biological, personal (psychological), and environmental (primarily social) dimensions of medical practice (e.g., Leigh & Reiser, 1980; Schwartz, 1982). The outbreak of the severe acute respiratory syndrome (SARS) epidemic in 2003 stimulated empirical research to expand this model and form a broader framework for public health (Cheung, 2004). For example, in response to SARS, wishful thinking was associated with avoiding public places and high-risk people, whereas empathic responding was related to preventive health behaviors (Lee-Baggley, DeLongis, & Voorhoeave, 2004). While dispositional optimism did not differ between Chinese and Canadians, unrealistic optimism was higher among Chinese than Canadians in the context of SARS, but Chinese reported more positive changes brought by SARS,

reflecting their dialectical views on negative events (Ji, Zhang, Usborne, & Guan, 2004).

Likewise, the Chinese values of prudence, industry, and civic harmony positively predicted

both direct (e.g., monitoring one's temperature daily and wearing a face mask to the doctor's

office) and indirect (e.g., building up one's resistance through exercise and taking health

supplements) preventive health-related behaviors to cope with SARS among Singaporeans

(Chang & Sivam, 2004). Thus, promoting effective coping strategies and health behaviors in

the general public should take into account social factors and cultural norms.

We use the Oxford Stringency Index (Hale et al., 2020), combining eight indicators of

containment and closure policies (including school closures, workplace closures, the

cancellation of public events, restrictions on size of gathering, closing public transport, stay-

at-home requirements, restrictions on internal movement, and restrictions on international

travel) to examine whether these strategies can explain East Asia's effective control of the

COVID-19 pandemic during the early period of outbreaks. The COVID-19 data were

obtained from the European Centrre for Disease Prevention and Control (ECDC; 2020) and

the John Hopkins University Center for Systems Science and Engineering (JHU CSSE; 2020)

database.

Based on time-series data from the day of the first identified case(s) to May 31, cross-

correlations between the Stringency Index (SI) and number of confirmed cases in mainland

China, Hong Kong, Taiwan, South Korea, Japan, and Singapore were computed after pre-

whitening, a procedure to remove the autocorrelation in one time series, to explore the lagged

associations for the two sets of time series. Figure 1 depicts the number of confirmed

COVID-19 cases from the day of the first case(s) to 100 days afterwards in each society, with

different colors indicating the change in SI (also see Figures S1a – S1f for each society

separately in supplementary materials). Highest cross-correlations are summarized in Table 1.

      Mainland China.   According to the Situation Report of the World Health

Organization (WHO) on 21 January 2020, cases of pneumonia unknown etiology detected in

Wuhan, China were reported to the WHO China Country Office on 31 December 2019 and

subsequently to WHO by the national authorities in China. After the spread of the novel

coronavirus in Wuhan and other parts of mainland China, the central government

implemented stringent control measures, including the lockdown of Wuhan on 23 January

2020, as well as suspension of public transport services and cancellation of major events (SI

jumping to 21 and higher, 22 days since the first reported cases; see Figure S1a in

supplementary materials). The cross-correlation result revealed that over the examined

period, increasing number of confirmed cases was associated with higher level of SI

subsequently in China, with a time lag of four days ($r = .199$ at lag -4; see Table 1). These

efforts successfully flattened the curve of infection by February, and there were more

imported new cases than locally transmitted new cases in March. The highest cross-

correlation between SI and number of cases later was significant, suggesting the effectiveness

of the implemented stringent measures in lessening the spread of COVID-19 ($r = -.299$ at lag +20).

Hong Kong.   In Hong Kong, the first two identified cases appeared in late January. A few days later, the Hong Kong government declared the outbreak as an emergency and responded immediately by exerting stronger border controls, reducing international travels, and closing schools (SI increasing to 41 and higher; indicated in yellow in Figure S1b in supplementary materials). The number of new cases per day remained low and in single digits until mid-March (about 50 days after the first cases). About two weeks later, further restrictions on international travel and gatherings were announced, but no lockdown was implemented (SI increasing to 61 and higher; indicated in orange in Figure S1b). The short delay in implementing containment measures was evident in the highest cross-correlation, as more confirmed cases initially were associated with higher SI later, with a time lag of six days ($r = .186$ at lag -6). Results also showed that these early containment and closure policies reduced subsequent number of cases ($r = -.268$ at lag +23). Moreover, citizens in Hong Kong have voluntarily adopted the use of face masks, a now recognized effective strategy to lessen transmission, which may also have contributed to the relatively low number of cases overall during the early period of the outbreak.

Taiwan.   Thus far, the impact of the pandemic has been small in Taiwan, with only 7 deaths as of May 31 and most cases imported. This was achieved without locking down cities

or closing schools, as indicated by the low levels of SI (i.e., 40 and lower across time).

Learning from the experience of SARS, the Taiwanese government responded to COVID-19

early on and rapidly, even before their first identified case in late January, by increasing

border stringency (increasing SI to 21 and higher; indicated in green in Figure S1c in

supplementary materials). In addition to tightened border control, the government banned the

export of face masks and other personal hygiene products to ensure adequate reserves for

their people. Facemask use is normative on public transport in Taiwan. Authorities also

communicated extensively to the public by distributing information through various forms of

media. The SI and confirmed cases changed simultaneously in Taiwan ($r = .230$ at lag 0),

which points to the timely and effective use of various measures in controlling the spread of

COVID-19. Their success in controlling the outbreak so far has been approved and praised

both locally and internationally.

South Korea.   Despite an early and massive outbreak in February-March (about 30

days after the first case), the South Korean government has been effective in controlling the

spread of the outbreak by implementing various control measures, with SI increasing to 41

and higher a few days after the outbreak (indicated in yellow in Figure S1d in supplementary

materials). The cross-correlation showed that increasing number of cases was associated with

higher SI later, with a time lag of two days ($r = .178$ at lag -2). The development and use of

medical technology for rapid and extensive testing, together with contact tracing and

healthcare, have played a key role in their stagewise success. For instance, mass testing has

provided health authorities with critical data to keep track of and contain the outbreak.

Supporting this, the cross-correlation result showed that higher SI was associated with fewer

cases subsequently in South Korea (r = -.203 at lag +29). The effectiveness of these strategies

may be attributed, at least in part, to the fact that the first outbreak occurred in one particular

region involving members of a religious group, named Shincheonji. The South Korean

government has also been recognized for its transparent and effective communication to the

public on managing the crisis and distributing COVID-19 related information.

Japan.   Due to the concern of the prospects for hosting the 2020 Olympics and the

economic impact of restrictions, the Japanese government implemented stronger border

control in early February and enforced more stringent measures including school closure in

late February, almost 37 days after the first identified case (SI increasing to 21 and higher;

indicated in green in Figure S1e in supplementary materials). In the early stage of combatting

the pandemic, the authorities were criticized for its passive response to the outbreaks,

ineffective case reporting and testing system, as well as lack of communication and

transparency. The delay in government response is reflected in the non-significant cross-

correlations between number of cases and subsequent level of SI. Nevertheless, when a surge

in infections occurred in March, the government and health authorities have encouraged

people to comply with social distancing and working from home measures on a voluntary

basis, and the Prime Minister declared a state of emergency in early April to enact

compulsory containment measures that could not be authorized under the current law. The SI

has increased to 41 and higher since March, about 48 days after the first case (indicated in

yellow in Figure S1e in supplementary materials). The cross-correlation result suggested that

these measures have been effective against COVID-19 in Japan without any lockdown ($r = -$

$.193$ at lag $+30$).

Singapore.   The Singapore government had initial success in containing COVID-19

by immediately implementing several containment measures, including border controls,

testing and tracing incoming passengers for potential risks, and by mandating mask-wearing.

The SI rose to 21 and higher in 15 days after the first identified cases (indicated in green in

Figure S1f in supplementary materials). A contact tracing application was also developed and

released in March, but the take-up and usage rate of the application was relatively low. In

April, a second wave of infections hit the poor migrant workers residing in overcrowded

dormitories. The number of cases in Singapore continued to rise and foreign workers had

accounted for the majority of them, despite that the government introduced a stringent set of

control measures (SI increasing to 41 and higher; indicated in yellow in Figure S1f). The

cross-correlation result revealed that stringent containment measures do not seem to have

been effective in lowering the number of cases in Singapore during the period examined. The

current situation has stimulated considerable debate about fairness and equity issues in the

society, which highlights the need for the government to work more in partnership with its people to regain their reputation as being a successful model for responding to the pandemic.

Analyzing such patterns and modeling predictions enable researchers to evaluate interventions at the country/society level. However, they cannot tease apart the effects of each control measure, nor model citizens' willingness to adopt behavioral changes mandated by policy. We suggest that vigilance (at the border, with contact tracing afterwards, and then extensive, fast, and inexpensive testing), civic responsibility (including heightened levels of concern for the health of others over personal freedom and convenience), underpinned by collectivist norms (including the public's willingness to call individuals out for failing to comply with safety rules) contributed to East Asia's effective control of the pandemic (Liu et al., 2020). Empirically, evidence from laboratory-confirmed COVID-19 cases and influenza surveillance data in Hong Kong shows that the transmissibility of COVID-19 and influenza declined after non-pharmaceutical interventions were implemented, including border restrictions, quarantine and isolation, distancing, and changes in population behavior (Cowling et al., 2020), providing support for our observed patterns. Conceptually, psychologists posit that social norms and cultural characteristics influence human behavior for COVID-19 pandemic response, in the sense that tight cultures, such as Singapore, Japan, and China, have strong social norms and low tolerance for deviance, thereby enforcing strict rules to suppress interpersonal transmission of the virus (Van Bavel et al., 2020).

In our opinion, multidisciplinary empirical research in health care and social sciences, personality and social psychology is needed for a clear understanding of how cultural values, social norms, and individual predispositions interact with policy to affect life-saving behavioral changes in different societies. In a large-scale 55-country study in late March and early April 2020, Götz, Gvirtz, Galinsky, and Jachimowicz (2020) found that the policy stringency and personality factors of openness to experience, conscientiousness, agreeableness, and neuroticism were all positively related to higher rates of staying at home, whereas extraversion was negatively associated with staying at home. Further, stricter government policies weakened the effects of openness and neuroticism on the behavior of sheltering-in-place. Other within-country and cross-cultural studies during the COVID-19 pandemic also show the interface between public health, personality and social psychological perspectives (e.g., Huang et al., 2020; Tong, Chen, Yu, & Wu, 2020; Zirenko, Kornilova, Zhou, Izmailova, 2020).

Using theories, constructs, and methods of social psychology in collaboration with health and medical sciences to analyze both society-level and individual-level data in multinational studies is required to provide additional evidence on how to prevent subsequent waves of infections. A recent attempt to explain cross-country variability in the transmission of COVID-19 is a 39-country study linking cultural practices of social relationships to growth curves of confirmed cases and deaths due to COVID-19 in the first 30 days of the outbreak

(Salvador, Berg, Yu, Martin, & Kitayama, 2020). The spread of the virus was found to be

faster in societies with higher relational mobility, where people have more freedom and

opportunities to form new relationships and terminate existing relationships, than in societies

with lower relational mobility, where interpersonal relationships are generally ascribed by

social roles and network structures. Analyzing individual-level data can facilitate the

understanding of how internalized cultural orientations, such as values, thinking styles, and

regulatory focus, shape individual responses and coping strategies to the COVID-19

pandemic, whereas identifying society-level patterns can illuminate how national culture

influences the collective actions and practices related to infectious diseases (Guan, Deng, &

Zhou, 2020). Therefore, a behavioral health pandemic response strategy for COVID-19 may

include biopsychosocial-cultural considerations to flatten not only the curve of disease spread

but also the curve of emotional distress (Kaslow et al., 2020). Theory and research should

take a global perspective and provide implications for healthcare professionals and policy

makers to manage the long-term impacts of the pandemic and optimize future

multidisciplinary efforts.

Data Availability Statement

Data on the Stringency Index were obtained from the Oxford COVID-19 Government

Response Tracker (OxCGRT): https://www.bsg.ox.ac.uk/research/research-

projects/coronavirus-government-response-tracker. Data on number of confirmed cases were

obtained from the European Centrre for Disease Prevention and Control (ECDC) and the

John Hopkins University Center for Systems Science and Enhineering (JHU CSSE) database:

https://github.com/CSSEGISandData.

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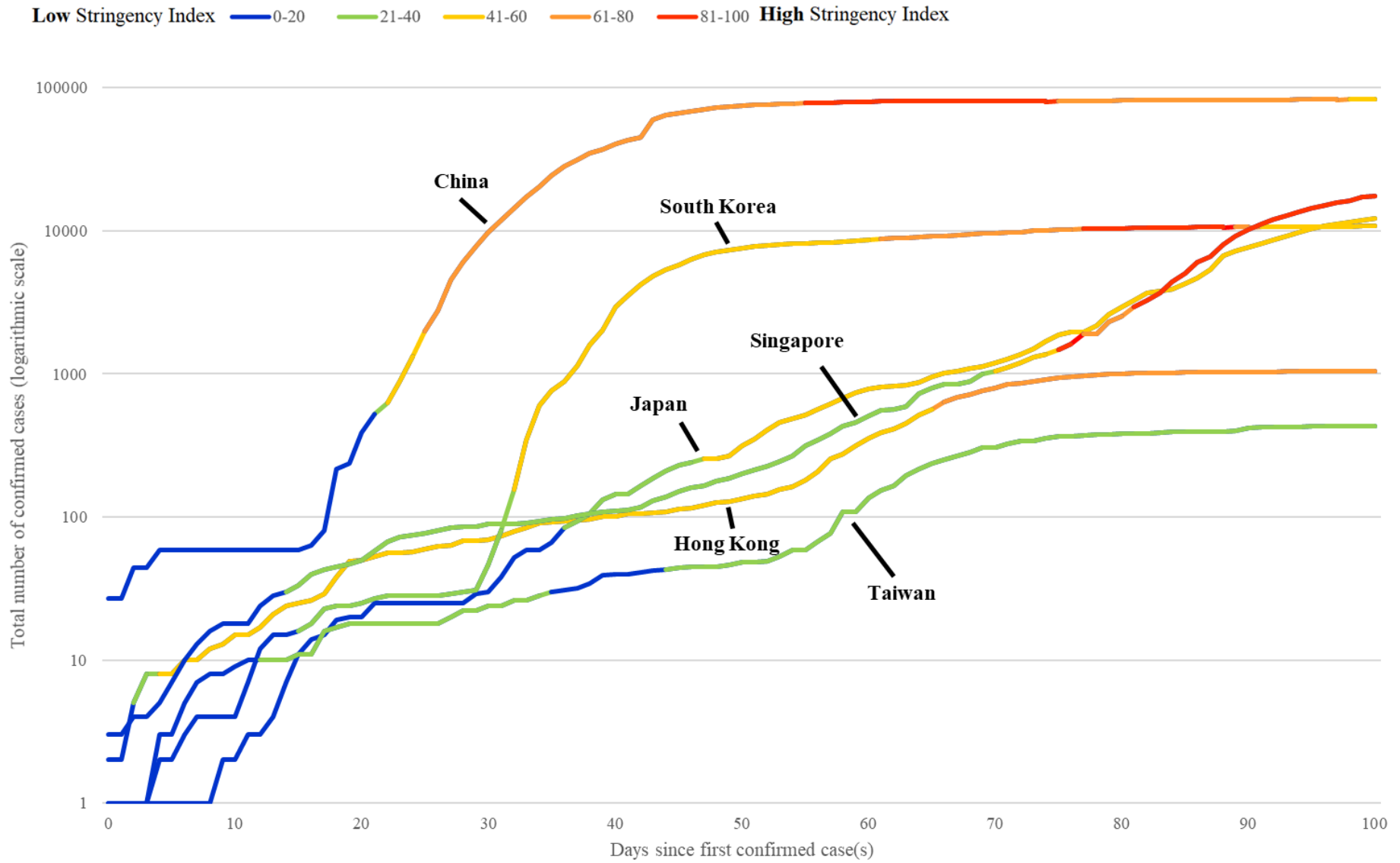
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Figure 1. Total number of confirmed COVID-19 cases by each of the six countries/societies since the first confirmed case(s).

Data on the Stringency Index were obtained from the Oxford COVID-19 Government Response Tracker (OxCGRT). Data on number of

confirmed cases were obtained from the European Centrre for Disease Prevention and Control (ECDC) and the John Hopkins University Center

for Systems Science and Enhineering (JHU CSSE) database.

Table 1

Summary of Highest Cross-Correlations between Stringency Index (SI) and Confirmed

COVID-19 Cases

	Confirmed cases leading SI		SI leading confirmed cases	
	r	time lag (day)	r	time lag (day)
China	0.199*	-4	-0.299*	+20
Hong Kong	0.186*	-6	-0.268*	+23
Taiwan[a]	0.219*	-1	-0.221*	+18
South Korea	0.178*	-2	-0.203*	+29
Japan	0.128	-11	-0.193*	+30
Singapore	0.149	-26	-0.049	+28

*$p < .05$.

[a]The highest cross-correlation is at lag 0, $r = 0.230$.