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Health and Public Health Implications of SARS/MARS/COVID-19 in Asian Countries

Yusuke Tsugawa*
(UCLA)

Atsushi Miyawaki
(The University of Tokyo)

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Health and Public Health Implications of COVID-19 in Asian Countries

Atsushi Miyawaki, MD, PhD [1]

Yusuke Tsugawa, MD, PhD [2,3]

Affiliations

[1] Department of Public Health, Graduate School of Medicine, the University of Tokyo, Tokyo, Japan

[2] Division of General Internal Medicine and Health Services Research, UCLA David Geffen School of Medicine, Los Angeles, CA

[3] Department of Health Policy and Management, UCLA Fielding School of Public Health, Los Angeles, CA

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Corresponding Author:

Yusuke Tsugawa, MD, PhD

Assistant Professor of Medicine & Health Policy and Management

UCLA David Geffen School of Medicine

Email: ytsugawa@mednet.ucla.edu

Tel: 310-794-2523

Abstract

This review presents impacts of the COVID-19 pandemic on population health in Asian countries. Compared to European countries, Asian countries in general implemented restrictive physical distancing measures earlier, kept them in operation longer, and experienced much fewer COVID-19 cases and deaths. However, the exact mechanisms through which Asian countries experienced fewer cases and deaths due to COVID-19 remains unclear, making it difficult to interpret whether countermeasures employed in these countries were effective. Still, regarding the aim of developing resilient healthcare systems, there remain several lessons from the COVID-19 pandemic experience in Asian countries that could inform more effective management of future pandemics.

Keywords: Public policy; public health; pandemic; non-pharmaceutical intervention; COVID-19; Asia

JEL codes: I10; I18; I19

Research Highlights

- The COVID-19 pandemic is a global public health and economic crisis causing severe illness among older adults and those with comorbidities; also, it is contagious from asymptomatic (infected) individuals, which makes controlling it’s spread especially difficult.
- Compared to European countries, Asian countries in general implemented restrictive physical distancing measures earlier, kept them in operation longer, and experienced much fewer COVID-19 cases and deaths.
- Lessons from Asian countries’ experiences should be informative when developing resilient healthcare systems that could be prepared more effectively for future pandemics.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic had a major impact on many aspects of our lives. Not only were large numbers of lives lost to this devastating infection, many countries experienced economic downturns due to lifestyle changes made to minimize the spread of the infection, and the implementation of policies that constrained economic activities, such as lockdowns and travel restrictions. An economic downturn may have a negative impact on population health as well, such as the increased mental illness and suicide rates that were observed in some countries. Many countries have struggled to find the right balance between controlling the pandemic and maintaining economic activities.

The COVID-19 infection is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and the first case was reported in December 2019 in Wuhan, China. As of the end of February 2021, more than 110 million confirmed COVID-19 cases had been reported worldwide, with more than 2.5 million deaths attributed to COVID-19 (World Health Organization, 2021). The pandemic disrupted access to healthcare services and had a tremendous negative impact even on non-COVID-19 patients. Initially, due to a lack of effective treatment and prevention (vaccine), non-pharmaceutical interventions (NPIs), such as lockdowns and school closures, were major countermeasures to the pandemic. However, while such NPIs may be effective in reducing the outbreaks, they can also impose negative economic impacts on society, represented by increased bankruptcies and rising unemployment rates, as well as negatively impacting children's educational attainment due to school closures (the long-term impact of such policies on children remains unknown). To simultaneously alleviate these negative effects on society and allow continued economic activities, robust and credible information concerning COVID-19 is critically important. Furthermore, comprehensive discussion about how the pandemic is affecting our health as a whole—including its secondary effects, especially in the context of Asian countries—is lacking. Here, we present a survey review of the current knowledge on COVID-19 and the pandemic's impact on public health in Asian countries. We also propose perspectives for the post-COVID-19 society and next pandemic.

2. Overview of COVID-19, in brief

Pathogenesis

Coronaviruses are single-stranded RNA viruses, named after their crown-like appearance under the electron microscope. Coronaviruses cause respiratory, gastrointestinal, and neurological diseases. The most common coronaviruses (229E, OC43, NL63, and HKU1) circulate in humans and cause the "common cold." Coronaviruses that are more pathogenic for humans and cause more severe symptoms include SARS-CoV-1 (cause of the 2002-2003 SARS-CoV pandemic), Middle Eastern respiratory syndrome coronavirus (MERS-CoV), and the virus causing the current pandemic, SARS-CoV-2 (Cevik *et al.*, 2020).

Several processes are considered to be responsible for the pathogenesis of COVID-19 (Wadman *et al.*, 2020). In the early stages of infection, SARS-CoV-2 replicates primarily in the upper respiratory tissues. Then, SARS-CoV-2 replicates in the lower respiratory tract and generates secondary viremia, followed by an extensive attack against organs including the heart, lungs, brain, blood vessels, kidneys, and gastrointestinal tract (direct viral damage). Although most people have mild illness and can recover during these stages, some people experience an enhanced immune and inflammatory response to the virus (called “cytokine storms”) in the late stage of the infection process, results in additional tissue damage (indirect viral damage). These cytokine storms may cause respiratory failure due to acute respiratory distress syndrome (ARDS), the leading cause of death attributed to COVID-19. Additionally, the damage to vessel systems leads to a hypercoagulable state, represented by a high incidence rate of pulmonary embolism and ischemic stroke, which is strongly associated with poor prognosis (Ramacciotti *et al.*, 2020; Tang *et al.*, 2020).

Symptoms

Common symptoms of the COVID-19 infection include cough, sore throat, fever, myalgia, fatigue, and headache. Fever, myalgia, fatigue, and headache have high specificilty for the diagnosis of the COVID-19 infection at hospital outpatient clinics during the epidemic period (Struyf *et al.*, 2020), and loss of smell and/or taste is reported to be highly specific (reported specificity of approximately 90%) to the COVID-19 infection at the population level (Menni *et al.*, 2020). Most of these relatively mild symptoms occur in the first week of onset of the disease and represent the earlier stage of infection. Some patients rapidly worsen and have more severe signs indicative of pneumonia (shortness of breath, confusion, and cyanosis), suggesting the later stages of infection and severe illness by COVID-19. An early report from China showed that up to 20% of patients with some symptoms transitioned to severe conditions (requiring supplemental oxygen), and 5% experienced critical conditions (requiring intensive care) (Wu and McGoogan, 2020).

Diagnosis

The standard method of testing for COVID-19 is real-time reverse transcription-polymerase chain reaction (rRT-PCR), which detects the presence of SARS-CoV-2 RNA fragments using samples from a nasal swab, sputum, or saliva. The PCR tests have high sensitivity and specificity for the diagnosis of COVID-19 among symptomatic patients when performed with appropriate methods and timing. It should be noted that PCR positivity does not necessarily indicate the presence of viral infectivity (Mina, Parker and Larremore, 2020). Even if the PCR is positive, there is little infectivity 10 days after symptom onset (He *et al.*, 2020). The WHO currently does not recommend the use of PCR testing as a criteria for deciding whether patients could be discharged from hospitals (World Health Organization, 2020c). They recommend 13 days of isolation (10 days for asymptomatic people), including three symptom-free days. Another diagnostic method for current COVID-19 infection is an antigen test. Antigen testing has moderate-to-high sensitivity and high specificity among symptomatic patients (Gremmels *et al.*, 2021; Pray *et al.*, 2021).

Treatment

Based on the pathogenesis processes of COVID-19, antiviral therapy is expected to be effective in the early stages of infection, while immunosuppressive therapy is considered beneficial in the later stages of infection. As of January 2021, the only therapy with robust clinical evidence (ascertained by several consistent randomized control studies) is Dexamethasone, a corticosteroid. Dexamethasone has been found to improve survival in hospitalized patients who require supplemental oxygen, with the greatest effect observed in patients who require mechanical ventilation (The WHO Rapid Evidence Appraisal for COVID-19 Therapies (REACT) Working Group *et al.*, 2020). However, it is not routinely recommended for noncritically ill COVID-19 patients (Shuto *et al.*, 2020). Remdesivir, an antiviral agent, may be promising for patients who require supplemental oxygen (it has been approved in several countries) (CDC, 2020b). However, the clinical effect of Remdesivir is not robustly proven: aggregated data from several RCTs did not support the efficacy of Remdesivir on mortality, need for mechanical ventilation, or time to clinical improvement (Piscoya *et al.*, 2020; World Health Organization, 2020e). Anticoagulation therapy for hospitalized patients may be promising given the pathogenesis. Several observational studies show that the use of anticoagulation therapy is associated with lower mortality (Nadkarni *et al.*, 2020; Wijaya, Andhika and Huang, 2020), but this has not been validated by large-size RCTs mainly because of the feasibilities of RCTs (Lopes and Fanaroff, 2020). Based on clinical trials showing no benefits from hydroxychloroquine and Lopinavir-ritonavir (off-label use of antiviral therapies), these medications are currently not recommended for the treatment of COVID-19 patients (Siemieniuk *et al.*, 2020).

Prognosis

COVID-19 is considered to have a much lower mortality rate than SARS or MERS (Petersen *et al.*, 2020) (**Table 1**). In contrast, the COVID-19 infection is reported to be more fatal than influenza (Baker, 2020). A study in France reported that the in-hospital mortality rate among patients hospitalized for COVID-19 was 2.8 times higher compared to that for influenza after adjusting for age (Piroth *et al.*, 2020). Another study conducted in the US found that patients hospitalized for COVID-19 had a five times higher risk of mortality compared to that for influenza after adjusting for potential risk factors (Xie *et al.*, 2020). Still, interpretation of this fatality rate for hospitalized patients should be treated with caution because it captures only hospitalized cases of COVID-19 as a denominator (Faust and del Rio, 2020). The infection fatality rate (IFR), calculated as the percentage of deaths among all infected persons—including confirmed, undiagnosed, and asymptomatic cases—may give a more accurate picture of the lethality of COVID-19. The IFR is estimated to be around 0.2% at all ages, according to more than 80 study estimates reported across countries until September 2020 (Ioannidis, 2020, 2021). The IFR is particularly high when limited to the elderly (1% for ages 65-74 years and 2% for ages > 75 years). The IFR for the young, healthy population is quite rare. The IFR for influenza is less reported; therefore, a comparison is difficult. According to the CDC report (CDC, 2020a), the estimated fatality rate in symptomatic influenza patients—including unconfirmed/undiagnosed cases—in the US, was 0.06 to 0.18% in all ages and 0.8 to 1.7% in ages 65+ years. These figures are comparable to the IFR of COVID-19 at first glance, but given the asymptomatic rate of influenza (16-50% according to previous reviews (Carrat *et al.*, 2008; Hamborsky, Kroger and Wolfe, 2015; Leung *et al.*, 2015)), the IFR is probably higher in COVID-19 compared to influenza. Worldwide, 1 billion persons are reportedly affected by influenza every year (World Health Organization, 2019), and the estimated number of deaths from influenza is 0.4 million (Iuliano *et al.*, 2018). Therefore, the IFR is roughly calculated as approximately 0.04%.

Transmission and re-infection risk

The virus spreads from the infected person's upper respiratory tract in small liquid particles that range from respiratory droplets to aerosols, when the infected person coughs, sneezes, talks loudly, or sings. Humans catch COVID-19 when the virus enters their mouths, noses, or eyes. Direct or close (less than 1-2 meters) contact with an infected person is a high-risk situation. The current evidence indicates that transmission is mainly through respiratory droplets in close-contact settings and by touching contaminated surfaces before touching one’s eyes, nose, or mouth (World Health Organization, 2020b). While these transmission patterns are similar to SARS, MERS, and influenza, the transmissibility of SARS-CoV-2 (represented by the basic reproductive number) is higher compared to those respiratory infectious diseases (Alimohamadi, Taghdir and Sepandi, 2020; Billah, Miah and Khan, 2020; He, Yi and Zhu, 2020; Liu *et al.*, 2020; Petersen *et al.*, 2020). Another unique feature of COVID-19 transmission is the high rate of transmission from individuals without symptoms (i.e., infection from individuals in the pre-symptomatic stage, representing approximately half of all infections) (Cevik *et al.*, 2020; He *et al.*, 2020; Petersen *et al.*, 2020). It is uncommon for SARS or influenza to be transmitted before the onset of illness. While the protection from spreading many infectious diseases including influenza requires people to wear masks only when they feel sick, given that the COVID-19 infection spread from asympomatic (but contagious) patients, the control of the COVID-19 outbreaks requires everybody to wear masks regardless of their symptoms. The fact that the COVID-19 infection spreads from asymptomatic individuals makes it especially challenging to trace and isolate infected individuals.

There is limited information about the re-infection rate of COVID-19. Recurrent positivity within 1-60 days after recovery is reported to be 12% on average (Mattiuzzi *et al.*, 2020), but most of these cases are probably due to protracted initial infections, given several studies showing positive PCR tests up to 90 days after the initial infection (Arafkas *et al.*, 2021). However, several reports have demonstrated true cases of reinfection (more than three months apart; virus has different genomic sequences) (Gupta *et al.*, 2020; Parry, 2020; Prado-Vivar *et al.*, 2020; Van Elslande *et al.*, 2020).

3. Evidence on Countermeasures to the COVID-19 Pandemic

Non-pharmaceutical interventions (NPIs)

In the first several months of the pandemic, vaccines had not been developed yet. Even after their development, there have been issues related to limited access to vaccines. Consequently, countries have not been able to rely solely on vaccines as effective measures against the pandemic. Therefore, NPIs have played, and are playing, important roles in preventing the spread of COVID-19. During past pandemics, governments in many countries used a wide variety of NPIs, including school/workplace closings, restrictions on gatherings, stay-at-home requirements, restrictions on domestic movement, and restrictions on travel (especially from and to areas with a comparably larger numbers of infections). Although these policies restricted people's activities and potentially resulted in economic downturns, evidence shows that a combination of these policies effectively suppressed the spread of COVID-19. Using a difference-in-differences method, Islam and colleagues (2020) found that the combination of school closures, workplace closures, restrictions on mass gatherings, public transportation closures, and lockdowns (stay-at-home requests and movement restrictions) were effective in the early stage of the pandemic across 149 countries.

In contrast, empirical evidence is limited regarding the effectiveness of individual physical distancing policies on the spread of COVID-19. Brauner and colleagues (2021) investigated the effect of individual physical distancing measures on the cases and deaths of COVID-19 across 41 European and other countries using a Bayesian hierarchical model. They found that restrictions on mass gatherings (limited to 10 or 100 people or less) and school and university closings were effective in reducing COVID-19 infections with statistical significance.

The effect of school closings on the spread of COVID-19 has been drawing attention. The Brauner and colleagues' paper could not disentangle the effect of school closings from university closings (Brauner *et al.*, 2021). Levels of social activity and patterns of risky behaviors (e.g., drinking alcohol at parties) could differ greatly between school students and university students. A study comparing students' parents and teachers from upper- and lower-secondary schools in Sweden—where upper-secondary schools closed but lower-secondary schools remained open during March-June 2020—showed that keeping schools open during the outbreak did not necessarily increase the risk of COVID-19 diagnoses among children's parents. However, it did lead to approximately two times higher odds of COVID -19 diagnosis among teachers (Vlachos, Hertegård and Svaleryd, 2021). This study suggests that school closings are associated with the risk of COVID-19 infection in school settings at the micro-level, but they do not reveal the impact of school closings at the macro level. School closings had a significant negative impact on mothers' psychological stress, and children's body weight (Esposito and Principi, 2020; Takaku and Yokoyama, 2021). Children are, in general, less likely to experience serious illness from COVID-19 (Ioannidis, 2021). From the perspective of protecting children's well-being, a balance between the positive and negative effects of prolonged school closings might need to be considered.

There is also limited evidence about where focused lockdown policies may be more effective, but epidemiological surveys have shown that clusters are more common in healthcare and long-term care facilities, bars/restaurants, and fitness centers (Furuse *et al.*, 2020; Jang, Han and Rhee, 2020), as well as super-spreader events such as choir practices (Hamner *et al.*, 2020). Recent studies using mobility data have identified locations that contribute significantly to the spread of infection, such as restaurants, fitness centers, hotels, and bars (Chang *et al.*, 2021).

<u>Vaccine</u>

The development of vaccines against COVID-19 was expedited through many initiatives. Among several available vaccines, the first COVID-19 vaccine with a completed phase III trial was the BNT162b2 mRNA vaccine, developed by Pfizer-BioNTech. This vaccine has been used most widely since it was first approved in the UK on December 2, 2020. The BNT162b2 vaccine requires two doses separated by three weeks and has an efficacy rate of 95% within seven days after the second dose of vaccination in the phase III trial (confirmed cases were 8 out of 18,198 participants who finished the second dose, compared to 162 out of 18,325 participants in the placebo group (Polack *et al.*, 2020)). In this phase III trial, the preventive effect for COVID-19 infection began to appear within 12-14 days after the first dose. How long the preventive effect lasts remains unknown, but the trial showed the effect appeared to last at least four months after the first dose. In real-world settings, reports from Israel showed PCR positive cases (for PCR positive, symptomatic, hospitalized, and severe cases, respectively) began to reduce within 28 days after the first dose of the BNT162b2 vaccine (Amit *et al.*, 2021; Dagan *et al.*, 2021). Another report from Israel showed viral load among COVID-19 cases substantially reduced 12 days after the first dose of the BNT162b2 vaccine, suggesting that it not only suppresses the onset of COVID-19, but also suppresses its transmissibility (Levine-Tiefenbrun *et al.*, 2021). In Israel, 80% of people aged 60 and older received their first dose of BNT162b2 in early January 2021 and their second dose in early February (for people aged 59 or younger, approximately 10% received the second dose by early February). From late January to early February, the number of COVID-19 infections and admissions among people aged 60 and older declined more than those among people aged 59 and younger, suggesting the vaccination program was effective at the macro-level (Burn-Murdoch and Srivastava, 2021). Other available vaccines include mRNA-1273 (Baden *et al.*, 2021), Gam-Covid-Vac (Logunov *et al.*, 2021), AZD1222 (Voysey *et al.*, 2021), and Ad5-nCoV (results from the phase III trial were unavailable as of February 2021). High binding and neutralizing antibodies persisted at least three months after the second dose of vaccination with mRNA-1273 (Widge *et al.*, 2021).

Limited evidence is available about the role of mutations in SARS-CoV-2 in the spread of COVID-19. However, mutations associated with the receptor-binding domain of the SARS-CoV-2 spike protein may affect the preventive effects of vaccines because this domain plays an essential role in viruses' entry to human cells. For example, in the United Kingdom, a new variant of SARS-CoV-2 known as B1.1.7 emerged with a large number of mutations, which is reported to have an increased transmitability and risk of death compared with the original SARS-CoV-2. Independently of B.1.1.7, other varians have been reported from Brazil and South Africa. In Manaus, Brazil, a second major outbreak occurred after January 2021, even though it was estimated that 76% of the population had been infected by October 2020 (Sabino *et al.*, 2021), which has been caused by a variant called P.1 carrying the mutation E484K (the mutations at site E484K have been shown to reduce the activity of neutralizing antibodies for SARS-CoV-2 (Weisblum *et al.*, 2020)) (Faria *et al.*, 2021). In South Africa, another variant known as B.1.351 that carries the E484K mutation—501Y.V2 had been identified around January 2021 and is reported to have higher transmissibility than the original variant (Pearson *et al.*, 2020)—vaccines being developed by Novavax are reportedly effective, but the efficacy rate is relatively lower compared to the original variant of SARS-CoV-2 (60% vs. 96%) (Mahase, 2021). Other variants have also emerged, including one in New York named B.1.526, the variant that contains the same E484 mutation as B.1.351. It remains unclear whether these variants cause more severe illness; efforts should be made to limit the emergence and spread of such variants given their transmissibility and potential resistance to vaccines.

4. COVID-19 Pandemic and Public Health

<u>Spread of COVID-19</u>

Countries in Asia (and Australia and New Zealand) have succeeded in suppressing the spread of COVID-19 compared to European countries and the US. **Figure 1** compares the trends in the mean number of new cases of COVID-19 (7-day average) and total cases of and deaths from COVID-19 among Asian countries with populations over 1 million vs. 28 EU countries (including the UK) (Ritchie *et al.*, 2020). The mean was weighted by each country's population. Asia has experienced fewer than five cumulative cases per thousand on average as of the end of January 2021 (**Figure 2**), which is much fewer compared to more than 40 cumulative cases per thousand on average in EU countries. Genetic factors specific to the Asian race would only minimally explain these differences, since even in predominantly white areas, such as Australia and New Zealand, the epidemic was suppressed. NPIs such as physical distancing policies should have played an important role in preventing the spread of infection during the period when there was no fundamental treatment for COVID-19, and the availability of vaccines was limited. In Panel D of **Figure 1**, we compare the strictness of physical distancing policies in Asia and the EU. We used the government stringency index, which is a composite score of nine physical distancing components (school closings, workplace closings, cancellation of public events, restrictions on gatherings, public transport closings, stay-at-home requirements, restrictions on domestic movement, international travel controls, and public information campaigns) available in *Oxford COVID-19 Government Response Tracker* (Hale *et al.*, 2020), and reflects the strictness of physical distancing policies. We compared trends in the weighted mean of this index (we calculated unweighted mean as well to minimize the effect of countries with large populations [e.g., China and India], which showed similar trends and thus were not shown). Asian countries began imposing stringent physical distancing policies earlier than European countries in the early stage of the pandemic. Also, Asian countries retained relatively high-level physical distancing policies even after the "first wave" of the COVID-19 outbreak (May-June 2020), even though they experienced much fewer cases during this first wave. These differences in physical distancing policies appear to suggest that the fewer cases of COVID-19 in Asia versus Europe may be due to the early and prolonged use of stringent physical distancing policies. Within Asian countries, there is still variation in the number of confirmed cases (**Figure 2**). Possible explanations for this variety in the number of COVID-19 cases in Asia may include socio-economic levels, income inequality levels (Oronce *et al.*, 2020; Scannell, Oronce and Tsugawa, 2020), and degree of stringency and enforcement of NPIs policies. It was concerning that the number of cases was relatively high in middle-income countries such as India and Nepal.

[Insert Figure 1 and Figure 2 here]

<u>Impact of the COVID-19 pandemic on non-COVID diseases</u>

The COVID-19 pandemic has indirectly impacted non-COVID-19 diseases as well. Here, we focus on the impact of the pandemic on non-COVID-19 patients, mainly in Asia. Negative impacts are derived from pandemic-related disruptions in healthcare systems and patients' avoidance of visiting health care facilities, both of which limit opportunities to receive appropriate, timely care. For example, disruptions in care for myocardial infarction has been reported. In a hospital located in Hong Kong, delays in performing percutaneous coronary interventions (PCI) for patients who visited an emergency department for acute myocardial infarction (AMI) were reported (Lotfi, Capatina and Kugelmass, 2020). A study from India also observed reduced cases of AMI patients and deterioration in patient outcomes (Showkathali *et al.*, 2020). In Taiwan, where early preventive measures have prevented community outbreak and kept the number of confirmed COVID-19 cases low (Wang, Ng and Brook, 2020), we did not see a significant change in the number of AMI admissions and door-to-device time of PCI (Li, Huang and Hwang, 2020).

Care for non-acute conditions also decreased during the pandemic. The WHO reported that countries worldwide, particularly low-income countries, experienced disrupted prevention and treatment services for non-communicable diseases (NCDs)—including treatment for cancer, cardiovascular disease, hypertension, and diabetes and rehabilitation services—at the early stage of the pandemic (World Health Organization, 2020d). Empirical studies have also reported a reduced volume of care for NCDs (Wright *et al.*, 2020; Ikesu *et al.*, 2021). Numbers of surgeries, especially elective/non-urgent surgeries, were especially reduced to allow for infection control and resource allocation at hospitals (Miyawaki, Tomio, *et al.*, 2020). Another disrupted area was public screening programs. For example, screening mammograms in Australia were suspended due to COVID-19 restrictions in the first wave of COVID-19 (March-May 2020) (Australian Institute of Health and Welfare, 2020). Japan also observed an 89% decrease in breast cancer screenings in May 2020 and a 38% decrease even in July 2020 (*Mainichi Daily News*, 2020). These delays in cancer screenings are expected to lead to increased cancer mortality in the future (Maringe *et al.*, 2020). Limited studies have investigated the empirical impact of this reduced care for non-acute conditions on patient health conditions, but a significant decrease in the number of colonoscopies in April and May 2020, and a subsequent increase in the number of obstructive colorectal cancers reported from

April to August in Japan (Mizuno *et al.*, 2020), suggest a potential negative impact on cancer patients.

In South Asia, there were concerns that delays or disruptions in care for HIV, tuberculosis, and malaria might lead to a substantial number of additional deaths and years of lives lost (Hogan *et al.*, 2020). Qualitative data from the Global Fund shows these disruptions in health service deliveries for HIV, TB, and malaria existed across many countries (The Global Fund, 2020). Moreover, the number of negative neonatal health outcomes, such as stillbirth, might increase in middle-income countries in the Asia-Pacific region (e.g., Nepal (Kc *et al.*, 2020)), where antenatal care was more likely to be affected by the pandemic than in developed countries.

Other negative effects include psychological impacts from the pandemic. In particular, increased numbers of people experiencing suicidal thoughts were reported (Czeisler *et al.*, 2020; Wise, 2020). For example, the suicide rate in Japan (Nomura *et al.*, 2021; Tanaka and Okamoto, 2021) has been rising since the second wave of the COVID-19 outbreak, especially among women and children. The reasons underlying Japan's increased suicide rate among young women remain unclear. South Korea also observed a drastic increase in the suicide rate among women in their 20s during the first half of 2020 compared with the same period of 2019 (Denyer and Kashiwagi, 2020). Mechanisms include the effects of unemployment, increased substance use (Taylor *et al.*, 2021), and the stress related to spending long hours at home, especially among women, which may increase their burden of unpaid work (Tanaka and Okamoto, 2021). For example, a quasi-experimental study in Japan showed increased anxiety among mothers with children, possibly due to school closures and stay-at-home requests (Takaku and Yokoyama, 2021). However, a recent study that analyzed the internet-based survey found that risk factors for serious psychological distress (SPD) among young women found that caregiving, domestic violence, fear of COVID-19, and COVID-19-related stigma were associated with higher rates of SPD, whereas economic situation (e.g., income level, employment type) and social isolation (e.g., marital status) were not (Yoshioka *et al.*, 2021).

Meanwhile, the COVID-19 pandemic and responses associated with it are collaterally providing positive health effects. These positive impacts include a decrease in non-COVID-19 communicable diseases, such as respiratory virus infection (e.g., influenza (Sakamoto, Ishikane and Ueda, 2020; Huh *et al.*, 2021), respiratory syncytial viruses (Tokyo Metropolitan Infectious Disease Surveillance Center, 2021)) and bacterial pneumonia. For example, influenza was rarely observed in the winter season in the southern hemisphere (including Australia and New Zealand) (World Health Organization, 2020a). In the northern hemisphere, the evidence of decreased influenza cases was mixed in the 2019-2020 season (possibly because the influenza season had almost ended when NPIs for COVID-19 widely began) (Itaya, Furuse and Jindai, 2020), but in the 2020-2021 season, the reported cases of influenza are much lower compared to previous years across countries (World Health Organization, 2020a). Although the individual NPI measures that have contributed most to the decline in influenza and other communicable diseases are not known, these findings suggest that appropriate NPIs are effective against these communicable diseases. Given the high disease burden of these communicable diseases in Asia (Simmerman and Uyeki, 2008), the importance of the NPI approach to mitigate the burden of communicable diseases should be reappraised as a lesson from this pandemic. There was also a significant reduction in diseases associated with infectious diseases, such as asthma attacks (Abe *et al.*, 2021; Huh *et al.*, 2021) and pediatric hospitalizations (Maeda *et al.*, 2020; Sano *et al.*, 2021). This may also be related to a decrease in air pollution due to the cessation of economic activities and reduced exposures to allergens due to wearing masks. Other potential positive impacts include a decreased number of accident deaths due to the reduced traffic caused by stay-at-home requests (Nomura *et al.*, 2020).

<u>Impact of the COVID-19 pandemic on excess deaths</u>

Given that there are both positive and negative effects of the pandemic on population health (COVID-19 infection itself plus the effect on non-COVID-19 patients), the net health impact of the COVID-19 pandemic may be worth investigating. How to measure the effect of a pandemic on each disease using a common index is a difficult question to answer, but one way is to compare the number of overall deaths during the pandemic to trends in previous years (excess deaths). These timely vital statistics are available only in selected countries. Figure 3 presents the number of all-cause death for Taiwan, South Korea (Giattino *et al.*, 2021), Japan (Ministry of Health Labour and Welfare Japan, 2020), and the Philippines (Philippine Statistics Authority, 2021), as well as the US (reference). It should be noted that only monthly data was available for Japan and the Philippines; weekly data was available for the other three countries. There was no increase in the number of all-cause deaths in Taiwan. South Korea, Japan, and the Philippines experienced a slightly larger number of all-cause deaths after July-August 2020 than the same period in the previous five years. Still, the degree of excess deaths was much smaller compared to countries severely affected by COVID-19, like the US.

[Insert Figure 3 here]

5. Summary and Future Policy Perspectives

Although COVID-19 is less deadly than SARS and MERS, it is contagious from healthy asymptomatic individuals, making it especially difficult to contain the spread of the virus. Although COVID-19 is similar to influenza in many respects, it is probably more deadly and infects more people. Notably, pathogenesis caused by enhanced immune/inflammatory response to the virus leads to a higher risk of severe illness and death than influenza. It is also unique in strong transmission from asymptomatic patients, making traditional public health interventions of isolating symptomatic patients inadequately effective. These features are what make COVID-19 a global public health crisis.

Asian countries experienced many fewer COVID-19 cases and deaths than European countries. These successes in suppressing the spread of COVID-19 resulted in a limited number of excess deaths, combined with the positive impact of physical distancing policies on non-COVID-19 diseases. This was reassuring given that Asia includes several middle-income countries where healthcare resources and systems are still limited and vulnerable compared to developed countries. Generally, Asian countries implemented restrictive physical distancing measures earlier and kept them in operation longer. This may be because of their past experience with

SARS and MERS (Gale and Jun, 2015; Gopalan, 2020), as well as their physical proximity to the origin of the SARS-CoV-2 outbreak, and their governments' more defensive attitude due to concerns about their own limited healthcare resources. Just as China's nationwide monitoring system for emerging infectious diseases was established after the SARS outbreak and contributed to the control of avian influenza, (Zhong and Zeng, 2006), Asian countries would have learned lessons from this pandemic regarding monitoring infectious diseases outbreaks, implementing appropriate evidence-based NPIs, (re)allocating healthcare resources, and vaccination policies. We need to take advantage of this experience and continue to prepare our healthcare systems for the next pandemic.

The major challenge many countries confront is finding an optimal balance between controlling the spread of the virus using NPIs and maintaining their economies. Some countries chose to partially open their economies with stimuli, such as financially incentivizing the use of restaurants or promoting domestic travel, at the risk of increasing the number of infections (Miyawaki, Tabuchi, *et al.*, 2020). However, evidence is mixed as to how countries may be able to increase economic activities without increasing the number of infections. Research shows, for example, that closing half of the restaurants (Chang *et al.*, 2021) or dividing a social group into two subgroups of equal numbers in time or space (Nishi *et al.*, 2020), may be effective in reducing the basic reproduction number [of COVID-19?] (R_0) to below one. It is important to note that strict and long-lasting physical distancing policies focusing on the most vulnerable population (e.g., older adults) may enable less strict NPIs for lower-risk groups (i.e., younger adults) (Acemoglu *et al.*, 2020). The role of government is more important than that of the private sector in effectively implementing these physical distancing policies (Jones, Philippon and Venkateswaran, 2020). This is an area that warrants further research conducted through collaborations between economists and public health researchers to better understand optimal policies.

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Figure legends

Figure 1. COVID-19 spread and strictness of physical distancing policies in Asia and the European Union (EU)
Source: Authors' analysis.
Note: We compared trends in the mean number of (A) new cases of COVID-19 (7-day average) and (B) total cases and (C) deaths from COVID-19 from January 1, 2020, to January 25, 2021, among Asian countries with populations greater than 1 million (as of 2020) vs. 28 EU countries (27 EU countries plus the UK). In Panel D, we compared the mean of the government stringency index (reflecting the strictness of physical distancing policies) developed in *Oxford COVID-19 Government Response Tracker* in Asia vs. the EU. The mean was weighted by each country's population.

Figure 2. Trends in total cases of COVID-19 in Asian countries
Source: Authors' analysis.
Note: We showed the total cases of COVID-19 from January 1, 2020, to January 25, 2021, for Asian countries with populations greater than 1 million (as of 2020).

Figure 3. Trends in the number of all-cause deaths in the selected Asian countries: 2020 vs. 2015-2019
Source: Authors' analysis.
Note: These countries were selected based on the availability of vital statistics.

Table 1. Comparison of COVID-19, MERS, SARS, and seasonal influenza

	No. of Confirmed cases†	**No. of deaths†**	**Case fatality rate (CFR)‡**	**Infection fatality rate (IFR)§**
COVID-19 (Dec. 2019-Feb. 2021)	110+ million	2.5+ million	2.2%	0.2%¶
MERS (Sep. 2012-Feb. 2021)	2,567	882	34.4%	34.4%
SARS (2002-2003)	8,098	774	9.7%	9.7%
Seasonal Influenza (/yr)	360 million ¶	0.4 million¶	0.1%¶	0.04%¶

†The number of cases of COVID-19 is derived from the World Health Organization (2021), MERS from WHO EMRO (2021), SARS from Petersen *et al.* (2020), and seasonal influenza (only for the estimated number of deaths) from Iuliano *et al.* (2018). Robust information on the number of confirmed cases of seasonal influenza worldwide is not currently available. Therefore, we used information from the United States, where an average of 14 million confirmed cases were reported annually from 2010 to 2019 (CDC, 2020a), by simply extrapolating to the total world population (7.7 billon/0.3 billon).

‡Case fatality rate was calculated by dividing the number of deaths by the number of confirmed cases. Note that the case fatality rate does not necessarily reflect disease severity because unconfirmed or undiagnosed cases were not accounted for in denominators.

§Infection fatality rate was derived from Ioannidis (2021) for COVID-19 and calculated from Iuliano *et al.* (2018) and the World Health Organization (2019) for seasonal influenza. We showed the same figure in IFR as CFR for MERS and SARS, assuming unconfirmed or undiagnosed cases are rare for these two diseases (He *et al.*, 2020; Petersen *et al.*, 2020)

¶Estimated value.

Figures

Figure 1.

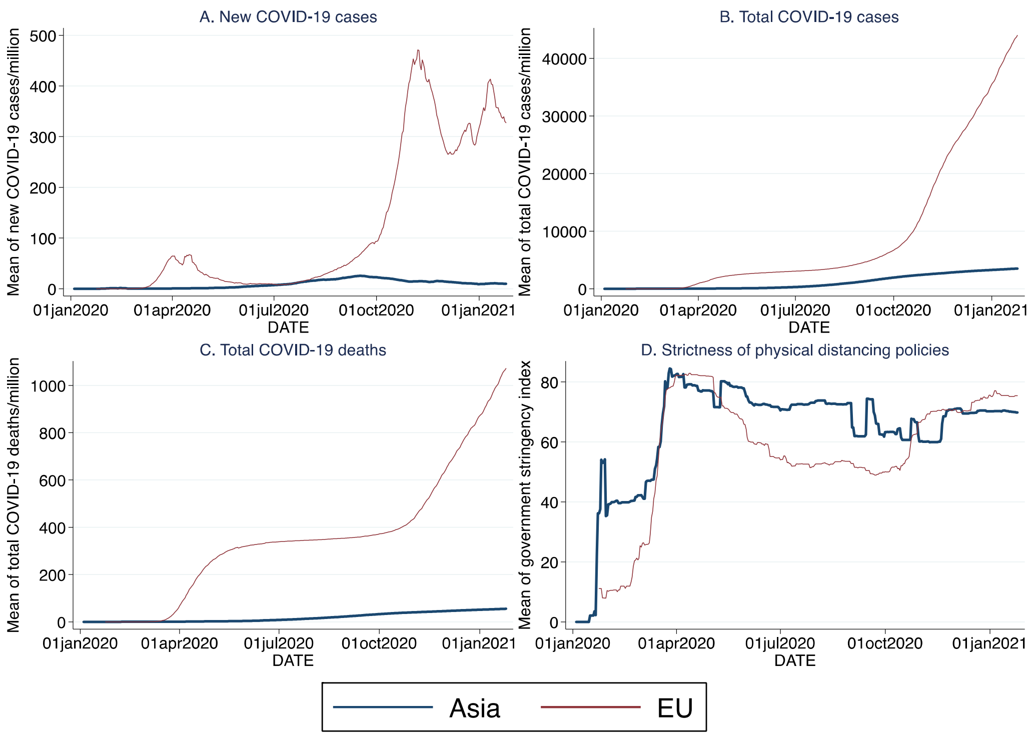


Figure 2.

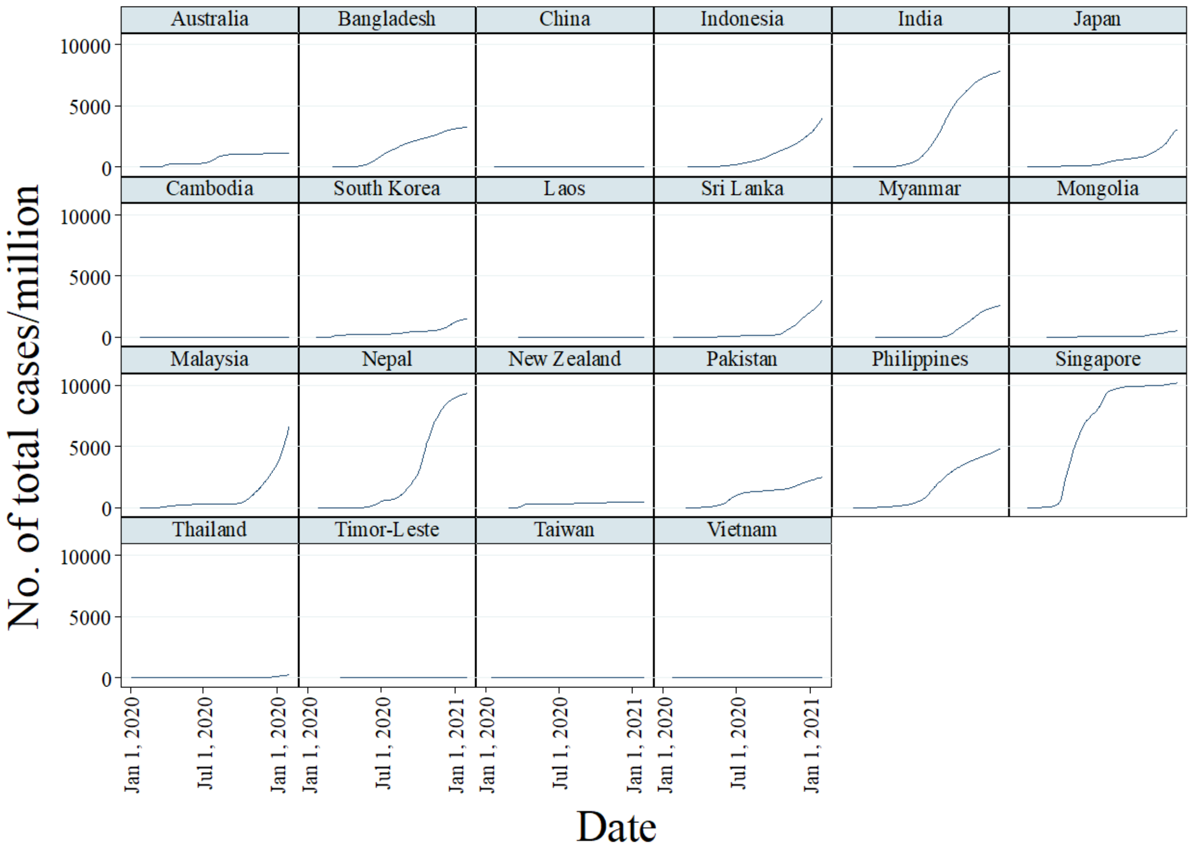
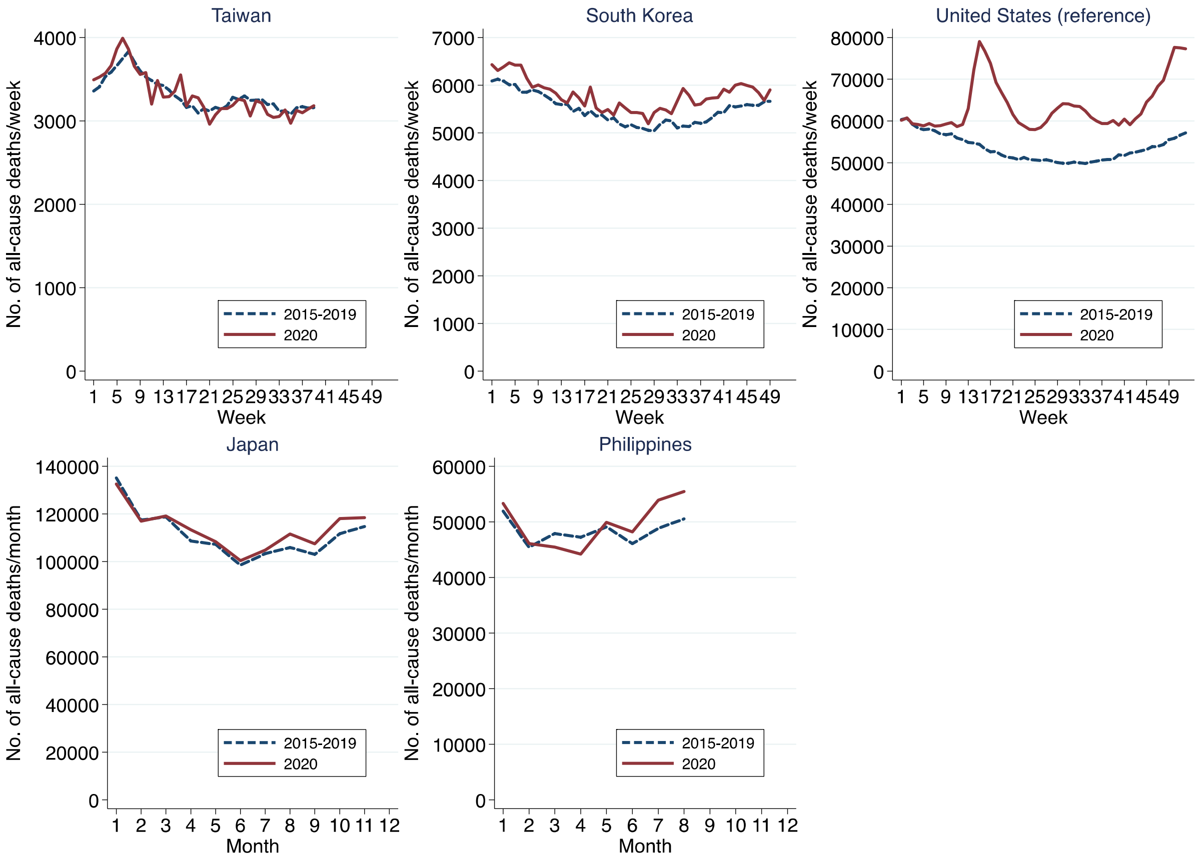

Australia
Bangladesh
China
Indonesia
India
Japan
Cambodia
South Korea
Laos
Sri Lanka
Myanmar
Mongolia
Malaysia
Nepal
New Zealand
Pakistan
Philippines
Singapore
Thailand
Timor-Leste
Taiwan
Vietnam
10000
5000
0
No. of total cases/million
Jan 1, 2020
Jul 1, 2020
Jan 1, 2021
Date

Figure 3.


Taiwan
South Korea
United States (reference)
Japan
Philippines
No. of all-cause deaths/week
No. of all-cause deaths/month
Week
Month
2015-2019
2020