Master's Thesis of City Planning

The Choice of Urban Spaces in the COVID-19 Era

- A Case of Three East Asian Cities -

코로나 시대의 장소 선택
- 동아시아 3개 도시를 사례로 -

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Abstract

COVID-19 has had an unprecedented impact on people's lives around the world. The spread of infectious diseases such as COVID-19 is known to be a spatial process, presenting different challenges depending on the region. Cities are home to more than half the world's population, with more than 90% of confirmed cases of COVID-19 concentrated in the area. In particular, cluster infections of COVID-19 have occurred in various urban spaces, including workplaces, restaurants, bars, religious facilities, healthcare facilities, shopping centers, and sports clubs. Previous studies have been conducted at an urban space-scale; however, studies that have sought to cover multiple urban spaces in one study and identify factors that affect visits to urban spaces during the pandemic have been so far insufficient. Conducting a case study in three East Asian cities, Seoul, Shanghai, and Taipei, this thesis examines individual's behavior- and perception-related factors that affect the use of urban spaces during the epidemic of COVID-19.

Seoul, Shanghai, and Taipei are among the earliest cities where the virus was initially imported. The coronavirus was introduced to those cities around the same time, and lots of policies were accordingly implemented to prevent the spread of the virus. Nevertheless, the three cities showed different patterns in the spread of COVID-19. In Seoul, the city repeatedly experienced the spread and mitigation of the disease. In the case of Shanghai, the city was inevitably affected by infected cases from other provinces in China at the beginning. Shortly after, the city implemented strict movement control

and strong containment measures, thereby maintaining a consistently low number of daily new confirmed cases. Taipei in Taiwan implemented strict and consistent border control, quarantine measures, health monitoring, and contact tracing immediately after the first case of COVID-19 was reported in Wuhan. Taipei is considered to be one of the world's best responders.

The study surveyed adults aged 19 or older living in each city. With the same questionnaire in different languages, the survey was conducted between September 23 and October 7, 2020 in the Seoul Metropolitan Area, September 8, 2020 and January 8, 2021 in the Shanghai Metropolitan Area, and October 15, 2020 and January 4, 2021 in Taipei. The sample sizes of the survey are: 537 in Seoul, 398 in Shanghai, and 152 in Taipei. In shedding light on the impact of individual's behavior- and perception-related factors or variables on urban space visits, a total of 14 types of urban space are classified into three categories (mandatory activity space, maintenance activity space, and discretionary activity space) based on literature review. For the statistical model, an ordered logit model is performed. Since the response variable is set as the level of urban space visits compared to before the COVID-19 outbreak, which is ordinal, employing the ordered logit model is justified under the consideration of the given data.

As a result of the analysis, behavior- and perception-related factors or variables that commonly influence the choice of all types of urban space in Seoul are identified as refraining from leisure or social activities and risk perception of COVID-19. It reveals that the more people desist from having leisure time outside and participating in social events, the less likely they are to visit all types of urban spaces. The higher the risk

perception of COVID-19, the lower the visits to all types of urban space. The study also finds that high perceived safety in the city influences the increase in visits to maintenance and discretionary activity space in Seoul, except for mandatory activity space. This can be interpreted that the more people perceive their city to be safe from COVID-19, the more frequently they visit those spaces.

In shanghai, compliance with preventive measures turns out to affect the decrease of all types of urban space visits. It can be attributed to the Chinese unique social and political characteristics, such as a high level of trust and loyalty in their government. Refraining from leisure or social activities is positively correlated with the decreased use of mandatory activity space only. Interestingly, higher risk perception of COVID-19 increases the use of maintenance and discretionary activity space in Shanghai. Since the epidemic was effectively controlled at the time of surveying, it is assumed that a higher risk of perception did not lead to a reduction in visits to those spaces.

Lastly, in Taipei, no factors that are commonly involved in the visit to all types of urban space are derived. The city was well-known for its highly advanced prevention and control strategies that lead to mostly COVID-19-free daily life during the global epidemic. This result can be explained that no behavior- and perception-related factors influenced changes in visiting behavior compared to before the COVID-19. Nonetheless, refraining from leisure or social activities turns out to influence the increased visits to mandatory and discretionary activity space, contrary to the results from the other two cities.

The study demonstrates urban resident’s behavior- and perception-related factors

associated with urban space visiting amid the COVID-19 epidemic. The study reconfirms some of the findings from previous studies. It also elucidates the results presented herein based on the context of the spread pattern of the virus, policy responses, and social and political backgrounds of each city. Lastly, this study emphasizes the importance of consideration of people's behavior and perception factors when designing infection prevention and control policies. It also highlights the importance of risk communication as policy implications.

Keywords: Coronavirus Disease 2019, COVID-19, Infectious diseases, Urban space, Urban space visit, Ordered logit model

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I. Introduction

1. Research Background and Objectives

Coronavirus Disease 2019 (COVID-19) was first reported in Wuhan, the capital city of Hubei province in China on December 31, 2019. As an acute respiratory disease caused by SARS-CoV-2, COVID-19 is primarily transmitted between people and spread through droplets produced when an infected person coughs, sneezes, and has a conversation (CDC, 2020). With clusters of confirmed cases in Wuhan in January 2020, COVID-19 began to spread rapidly to not only other parts of China but numerous countries, including Thailand, Japan, South Korea, and the U.S.. The total number of confirmed cases of COVID-19 around the world has reached 197 million, with 4.22 million deaths as of late July 2021.

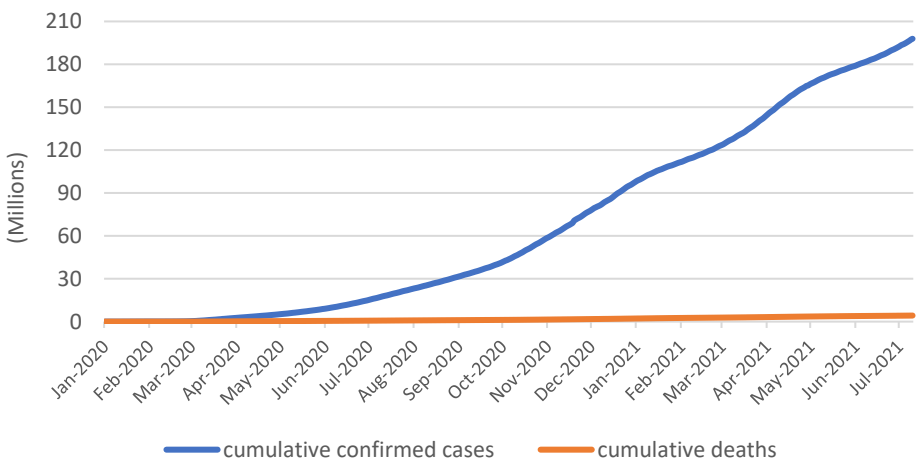

Figure 1. Cumulative COVID-19 confirmed cases and deaths worldwide from January 22, 2020 [Data from Dong et al. (2020)]

The spread of infectious diseases such as COVID-19 is a spatial process (Cordes & Castro, 2020). Two diseases posing a risk to human life in the 21st century, severe acute respiratory syndrome (SARS) and Middle Eastern respiratory syndrome (MERS), have also spread locally and spatially (Qian et al., 2009; Kuebart & Stabler, 2020), presenting different challenges depending on the region (Meng et al., 2005; Gardner et al., 2016). The incidence rates, confirmation rates, and death tolls showed heterogeneous distribution by region (Al-Ahmadi et al., 2019; JHU CSSE, 2020). The distribution and spread of these infectious diseases are predominately caused by people moving across regions and borders via various means of transportation (Arthur et al., 2017; Charu et al., 2017).

Cities are home to more than half the world's population and the center of economic growth and innovation. Moreover, they are also believed to be vulnerable to natural and human-made disasters due to a high population density and a concentration of various activities (Sharifi & Khavarian-Garmsir, 2020). In the context of COVID-19, this vulnerability has been shown to be accurate, with approximately 90% of the world's confirmed cases of COVID-19 concentrated in urban areas (UN, 2020).

Cluster infections of COVID-19 have occurred in various urban spaces, including workplaces, restaurants, bars, religious facilities, healthcare facilities, shopping centers, and sports clubs (ECDC, 2020; Kim, 2020; Liu et al., 2020; Salama, 2020; Mayer Brown, 2020; CECC; 2020). Accordingly, many countries have temporarily suspended or restricted the operation of multi-use facilities and community facilities in urban areas and imposed strict social distancing measures (Hsiang et al., 2020; KDCA, 2020a; IMF, 2020; MHCLG, 2021).

Likewise, in order to understand the dynamics of COVID-19, it is necessary to take a spatial approach (Poom et al., 2020; Smith & Mennis, 2020). Previous studies have already examined the spread of the virus in urban spaces (Cai et al., 2020; Kim, 2020; Liu et al., 2020; Salama, 2020; Jang et al., 2020; Wei et al., 2020; Chang et al., 2021; Wei et al., 2021); however, studies that have sought to cover multiple urban spaces in one study and identify factors that affect the level of the visit to urban spaces have been so far insufficient. Conducting a case study in three East Asian cities, this thesis focuses on investigating individual's behavior- and perception-related factors that affect the use of urban spaces during the pandemic.

2. Research Scope and Method

1) Research Scope and Data

This thesis's study area is the Seoul Metropolitan Area in South Korea, which includes Seoul, Gyeonggi Province, and Incheon; Shanghai Metropolitan Area in China; and Taipei in Taiwan. All three cities are adjacent to or in China, where the first COVID-19 case was reported. The unit of analysis of this study is individuals living in each city and aged more than 19 years.

The primary data were derived from a structured online survey conducted in the three cities. The survey was designed to investigate changes in the individual's perceptions and behavior during the COVID-19 crisis. With the same questionnaire in different languages, the study conducted surveys in the three cities in a similar period: between September 23 and October 7, 2020 in Seoul Metropolitan Area (n=537), between September 8, 2020 and January 8, 2021 in Shanghai Metropolitan

Area (n=398), and from October 15, 2020 to January 4, 2021 in Taipei (n=152).

2) Research Method and Conceptual Framework

Below is the method and framework of the thesis to identify individual's behavior and perception factors that influence urban space visiting.

First, this thesis presents a theoretical background of epidemics regarding the choice of urban spaces. The impact of COVID-19 on urban space, changes in the use of urban space, and behavior- and perception-related variables associated with the use of urban spaces are reviewed.

Second, in the methodology section, study areas are selected to research factors involving the use of urban spaces. This thesis set its study area as Seoul Metropolitan Area, Shanghai Metropolitan Area, and Taipei. Although all are located in East Asia, they were under a different situation concerning COVID-19. Then, an ordered logit model is introduced as a statistical model. Since the dependent variable is the level of visits to urban spaces based on an 11-point Likert-type *rating* scale, the ordered logit model was applied.

Third, the descriptive statistics of survey respondents and survey questions are presented. Here, as a measure of internal consistency, Cronbach's alpha coefficient is used to group several questions into relevant factors. Then, this study performs the ordered logit model for each city using the factors and variables based upon the preceding discussion. In presenting results, 14 different urban spaces surveyed are classified into three categories according to previous studies.

Lastly, the thesis provides interpretations of each city's results to better understand

people's behavior and perception in the context of the choice of urban space during the pandemic. This thesis ends with a summary of the results and policy implications.

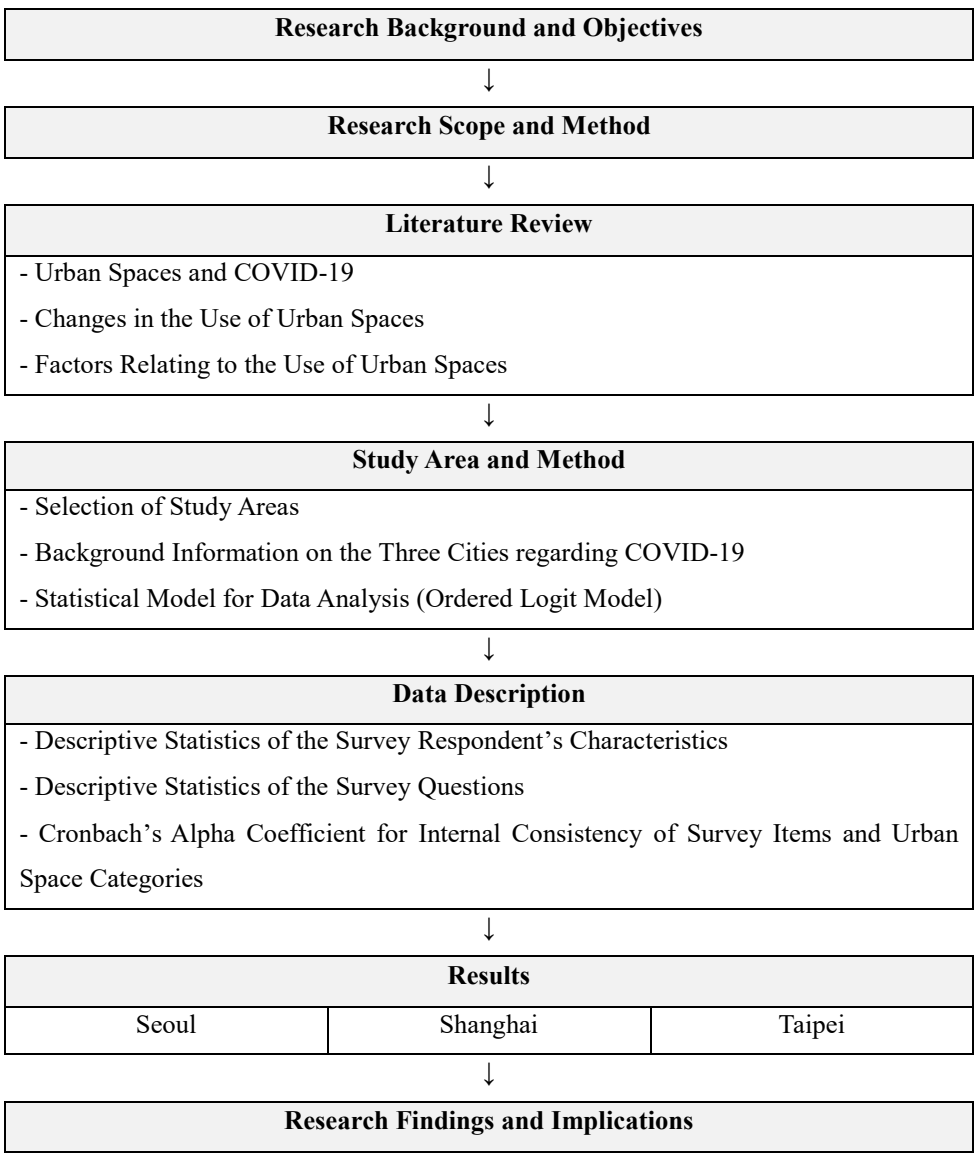

Figure 2. The flow of the thesis

II. Literature Review

In this section, existing studies are reviewed to examine the impact of infectious diseases on the choice of urban spaces.

The first section of the literature review discusses the relationship between urban public spaces and COVID-19. The second section reviews studies on changes in urban space visits since the outbreak of COVID-19 and identifies urban spaces that are expected to have notable changes in the number of visits. The last section reviews behavior and perception factors related to urban space visiting during the pandemic. In particular, in the last section, the effects of risk perception of infectious disease on personal preventive behavior, perceived safety in the city, and preventive measures are examined to shed light on the reasons for behavioral changes.

1. Urban Spaces and COVID-19

Traditionally, urban public space was defined mainly as the concept of accessibility (Serdoura & Ribeiro, 2007; Jalaladdini & Oktay, 2012; Sendi & Goličnik Marušić, 2012). Unlike private spaces such as bedrooms, public space was considered collectively consumed goods or resources (Webster, 2007). With the evolution of the definition of urban public space in social science, its definition was expanded to places where people mingle, interact, and gather with strangers (Jones et al., 2015; Shawket & El Khateeb, 2020). Accordingly, urban public spaces now include various places such as public transportation, markets, shopping malls, barbershops, bars, cafes, gyms, and restaurants in the urban area along with streets,

parks, and squares that were the classic example of the urban public space (Jones et al., 2015; Shawket & El Khateeb, 2020; Martínez & Short, 2021).

However, urban spaces where people gather and interact can be easily affected by infectious diseases. With more than 90% of COVID-19 cases concentrated in urban areas (UN, 2020), the impacts of the pandemic are more disastrous in urban environments. After the outbreak of the COVID-19, many countries have banned and restricted the use of multi-use facilities in cities or closed them (Honey-Rosés et al., 2020; Shawket & El Khateeb, 2020). About a half of the world's population experienced lockdown and was under the influence of strong containment measures (OECD, 2020). Likewise, policy responses to curb the spread of COVID-19 have changed the relationship of citizens to their streets, public facilities, and public spaces (UN-Habitat, 2020).

In addition, COVID-19 indirectly or directly has restricted political, economic, and social activities in urban spaces by disabling large-gatherings. The change in the use of urban space is regarded to have deepened social segregation and inequality. It can also be predicted that the lack of social interaction with others in urban public spaces may bring the difficulty of forming and maintaining a new human network in urban society. (Honey-Rosés et al., 2020)

On the other hand, COVID-19 has created many opportunities and innovations regarding urban spaces. For example, citizens who start working from home rather than office would change business norms (Richter, 2020). The movement restrictions and closure of wholesale and retail shopping centers have led to the rapid growth of the e-commerce and online shopping (Jílková & Králová, 2021). In addition, multiple countries have rediscovered the value of green space and its mental and

physical health benefits throughout the pandemics (Venter et al., 2020; Burnett et al., 2021).

In summary, the outbreak and spread of COVID-19 have brought a complex effect on the use of urban space. It opened the stage for advanced discussions and reshaped the roles and functions of urban spaces. It is anticipated that COVID-19 would change the way people use urban spaces and facilities in an unpredictable way, and the world would be hit hard by the change in the future.

2. Changes in the Use of Urban Spaces

People's mobility had decreased hugely and globally after the declaration of pandemic by the World Health Organization (WHO) and the national emergency declaration of each country (Lee et al., 2020; Corpus-Mendoza et al., 2021). Google LLC (2021) tracked visits to various urban spaces (retail and recreation, grocery and pharmacy, parks, transit stations, workplaces, and residential) from February 2020 and supported that different visit patterns appeared depending on the region and the type of urban space. Changes in the use of urban spaces can also be traced by the household or personal consumption and expenditure data during the pandemic. Consumption and expenditure are the major activities that have formed the modern concept of public space since the 19th century (Sadik-Khan & Solomonow, 2017). They are expected to be the most heavily affected by the pandemic (Honey-Rosés et al., 2020). Examining this data suggests that individuals have changed the number of goods and services they previously consumed before the pandemic (Baker et al., 2020). Alexander and Karger (2020) identified an increase in spending on food delivery services in the U.S.. Another study that analyzed daily transaction data in

China found that spending in restaurants, nightlife activities, and travel and tourism have considerably decreased since the beginning of the pandemic, with a striking impact on overall spending levels (Chen et al., 2020).

To sum up, the above studies indicate that people have refrained from activities such as traveling and dining out to prevent the spread of the virus. As a result, they have begun to more frequently use food delivery services rather than eating out. It is accordingly logical to assume that there have been concurrent changes in the use of urban spaces associated with travel, nightlife, and food and drink services.

3. Factors Relating to the Use of Urban Spaces

1) Risk Perception of Infectious Disease

Protection motivation theory, which was first introduced in 1975, has been widely used as a framework to predict protective behaviors in response to health threats. According to the theory, the perceived severity of threats is one of the factors that affect protective behaviors (Rogers, 1975; Kowalski & Black, 2021). Risk perception of infectious disease is believed to have a link to preventive health behaviors such as washing hands, wearing face masks, social distancing, and avoiding crowded places (Leppin & Aro, 2009; Katz et al., 2012; Wang et al., 2018; Zhang et al., 2019; Wise et al., 2020). Surveying 819 university students in the Mid-Atlantic region of the U.S., Katz et al. (2012) found that the higher the perceived risk of H1N1 (novel swine-origin influenza A), the more preventive health behavior among the students. Using a health model and protective action decision model, Wang et al. (2018) discovered that risk perception affects an individual's willingness

to follow government-recommended protective actions to avoid contact between people during the H7N9 (avian influenza A) outbreak. A recent study on COVID-19 also revealed the link between risk perception and engagement in protective behavior (Wise et al., 2020). The study by Wise et al. (2020) conducted a cross-sectional and longitudinal survey in the U.S. and showed that higher risk perception increased basic protective behavior such as hand washing and social distancing. The perceived probability of getting infected was found to be powerful for predicting hand washing and social distancing.

This study presumes that this kind of behavioral change caused by risk perception would affect the visits to urban spaces since the perceived risk of infectious disease differs depending on the characteristics of urban space (Sadique et al., 2007). The choice of urban spaces during the COVID-19 era could, therefore, be related to perceived levels of risk. Furthermore, since individual behavior patterns can affect the spread of infectious diseases (Abdelrahman, 2020), a better understanding of the link between risk perception and visiting behavior would be of great value.

2) Perceived Neighborhood Safety

Although not many studies have addressed a link between the perceived safety in the city and the use of urban spaces of citizens, the perceived safety in a city or neighborhood can be considered to affect the physical behavior of people. Lenhart et al. (2017) found that adolescents with lower perceived neighborhood safety were less likely to participate in physical activity. The author also stated that perceived neighborhood safety is a distinct environmental construct related to urban resident's

behavior. Addressing an individual's perception of neighborhood safety in this study can have importance considering that it is affiliated with interactions and connections to the community (Ziersch et al., 2005; Baum et al., 2009).

Crime and COVID-19 may share a similarity in that they are external threats individuals cannot control. In crime studies, a higher safety perception in the neighborhood is associated with active physical activities yet having an inconsistent result depending on the characteristics of respondents (Evenson et al., 2012; Oyeyemi et al., 2012). One study suggests that parent's safety perception against crime is positively correlated with children's frequent physical activities at public recreation spaces (Tappe et al., 2013). Likewise, when people feel the environment in the city or region is safe from external threats, it could cause behavioral changes in terms of their urban space visiting.

3) Preventive Measures and Policies

Before the absence of an effective vaccine or any approved treatment, the world had widely used preventive measures and policies to delay or curb the spread of COVID-19 (IMF, 2020). During the COVID-19 pandemic, most countries worldwide implemented various preventive measures and policies, including social/physical distancing, lockdown, and quarantine. Thus, a set of non-pharmaceutical interventions play roles in controlling the spread of infectious diseases, and evidence supports that they effectively prevent the spread of infectious diseases, including COVID-19 (Ahmed et al., 2018; Papadopoulos et al., 2020; Wang et al., 2020a). The prevention measure restricted the use of multi-use facilities and

community facilities in a city (Hsiang et al., 2020; KDCA, 2020a; IMF, 2020; Papadopoulos et al., 2020; MHCLG, 2021). More precisely, they include movement restrictions, stay-at-home restrictions, closure of public spaces, cancellation and postponement of public events, operation of the facility with limited opening hours, and prohibition of certain types of activities that are expected to pose potential threats to public health.

Even though the detailed contents, intensity, timing, and duration of the policy may vary from city to city, it is valid to assume that visiting behavior of people to urban spaces has changed significantly due to governmental preventive measures during the pandemic.

4. Summary and Implication

This chapter investigated the link between COVID-19 and the individual's use of urban spaces. COVID-19 has had a tremendous social, economic, and political impact on urban spaces where people gather and interact. Changes in the use of urban space were revealed through mobility data (Google LLC, 2021) and consumption and expenditure data (Alexander & Karger, 2020; Baker et al., 2020; Chen et al., 2020). Part of the reason for this would be that these activities occur in spaces with a high probability of infection and perception of transmission risk (e.g., shops and restaurants) (Sadique et al., 2007; Sun & Zhai, 2020). Moreover, the chapter confirmed the link between risk perception and individual preventive health behaviors, including not visiting crowded spaces (Leppin & Aro, 2009; Katz et al., 2012; Wang et al., 2018; Zhang et al., 2019). The perceived safety in the city and

prevention measures of COVID-19 could also lead to people's behavioral changes in connection with the choice of urban spaces.

III. Methodology

For examining people's behavior- and perception-related factors that affect the level of visits to urban spaces, the study conducts a case study.

1. Study Area

In this chapter, the analysis is conducted on the three cities in East Asia, where the cities faced the impact of the disease at an early stage. The study sets Seoul in South Korea, Shanghai in China, and Taipei in Taiwan as the spatial scope of the study. [1] At the beginning of the global spread of COVID-19, the virus was introduced to those cities around the same time, and consequently, lots of policy measures were implemented to prevent the spread of the virus.

[1] In the analysis, Seoul and Shanghai are analyzed in metropolitan units as they share and form the same living area as the surrounding area.

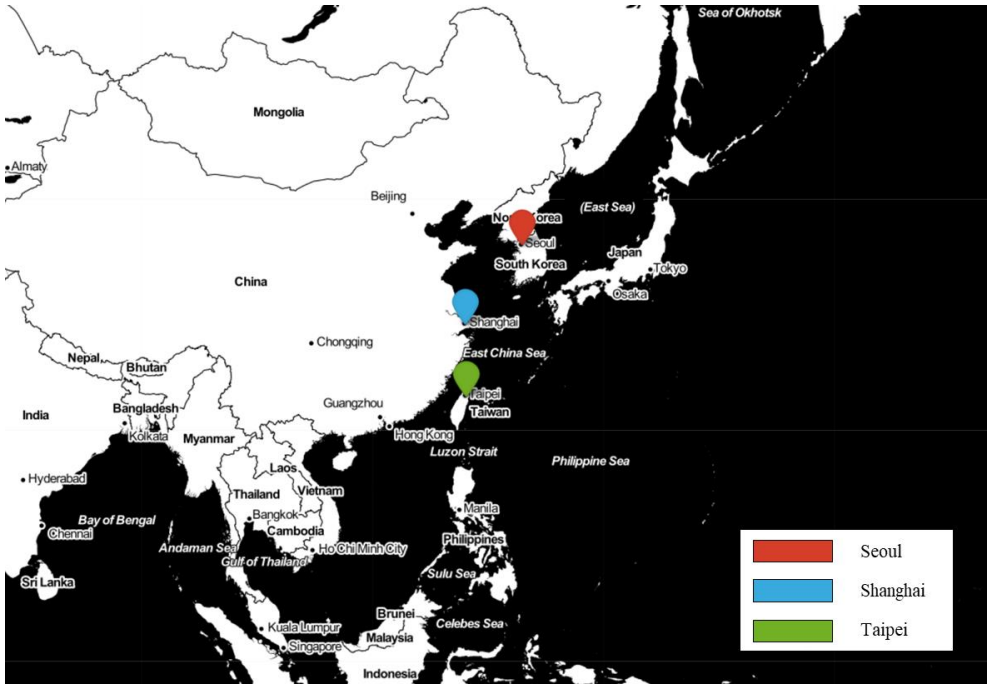

Figure 3. Location of the three cities (Map created in Python 3.7.11)

Seoul, Shanghai, and Taipei are the capitals or megacities with the highest population density in each country and region (UN, 2018; Taipei City Government, 2019). In addition to the highest population density, the three cities function as the most leading economies and major transport infrastructure (ADB, 2014; Taipei City Government, 2019; Boxer, 2019).

However, the three cities show different patterns in the spread of COVID-19. Since the first confirmed case was imported in Seoul, the city repeatedly experienced the spread and mitigation of the virus. In 2020, the Seoul Metropolitan Area faced three waves of COVID-19 (KDCA, 2020b; Shim et al., 2021). In the case of Shanghai, the city was inevitably affected by COVID-19 cases from other provinces in China as it is a megacity located in Mainland China; however, it is evaluated as a

city that effectively controlled the disease with strict movement control and strong containment measures (Dang et al., 2020). Lastly, Taipei implemented strict and consistent border control, quarantine measures, health monitoring, and contact tracing immediately after the first cases of COVID-19 were reported in Wuhan, making it one of the worlds' best responders (Wang et al., 2020b; Kuo, 2021).

To sum up, Seoul has continuously experienced the spread and mitigation of the coronavirus. Shanghai has controlled the virus effectively, although many cases had been imported in the early stage of its spread. Taipei had been relatively free from the global spread of COVID-19 owing to a bundle of suitable and in-time measures. By identifying the factors affecting urban space visits in three cities with different backgrounds, this study attempts to present implications for establishing proper preventive and containment measures.

1) Seoul

On January 20, the Seoul Metropolitan Area, which includes Seoul, Gyeonggi Province, and Incheon, saw its first confirmed case of COVID-19. Since the first case has been identified, the number of new confirmed cases goes up and down in the area, recording a total of 129,196 confirmed cases at the end of July 2021 (SGIS, 2021). In 2020, the Seoul Metropolitan Area suffered two waves between February and July and the third wave in November.

The monthly cumulative confirmed cases of COVID-19 from March 2020 to July 2021, which cover the survey period of Seoul, are shown in Figure 4. As of the end of January 2021, when the survey study was completed in all three cities, the number

of confirmed cases in the Seoul Metropolitan Area accounted for about 63.2% of the country's total cases.

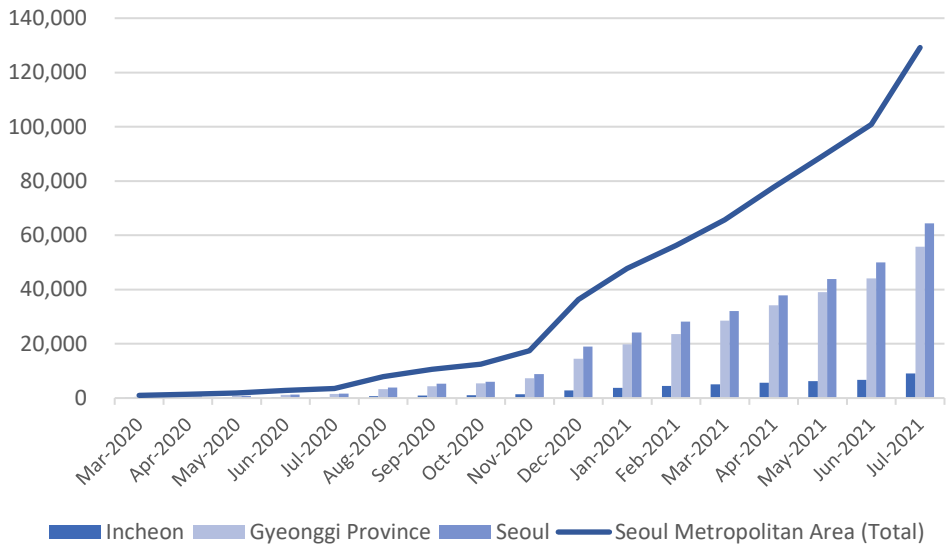

Figure 4. Cumulative COVID-19 confirmed cases in Seoul Metropolitan Area between March 2020 and July 2021 [Data from SGIS (2021)]

The characteristics of the preventive measures in South Korea, including the Seoul Metropolitan Area, are that the social distancing levels are divided into five categories based on the weekly average of daily infected cases. Rules for urban space use also apply differently depending on the five levels. In Phase 1 called "preventive measures in day-to-day life", basic hygiene measure becomes mandatory for operating urban spaces. When the level is upgraded to the "local transmission stage", which consists of Phase 1.5 and Phase 2, the number of visitors and duration of staying are limited, or visits to specific urban spaces are prohibited. Nightlife facilities are mainly subject to be controlled. In Phase 2.5, named "nationwide

community transmission stage", door-to-door sales and gatherings at karaoke rooms and indoor standing concerts are banned, as well as implementing tightened restrictions and monitoring at other facilities. Lastly, in Phase 3, which is the strictest level in the "nationwide community transmission stage", operation of all public facilities is restricted except for the essential facility, and suspension of opening national/public facilities is made. The higher the phase, the tighter the limit on the number of private gatherings/events and restrictions on their use throughout sports viewing, schooling, religious activities, and work (KDCA, 2020c). During the survey period conducted in the Seoul Metropolitan Area, the social distancing remained in Phase 2 (MOHW, 2020).

2) Shanghai

Shanghai saw its first confirmed cases of COVID-19 on January 20, 2020. At the end of July 2021, a total of 2,312 confirmed cases with 2,242 recovered cases and seven deaths were reported within Shanghai city only. The monthly cumulative confirmed cases of COVID-19 in Shanghai city only from March 2020 to July 2021, which cover the survey period conducted in the Shanghai Metropolitan Area, are shown in Figure 5. During the survey period, the average of daily new cases in the city was 5.161, which is relatively low.

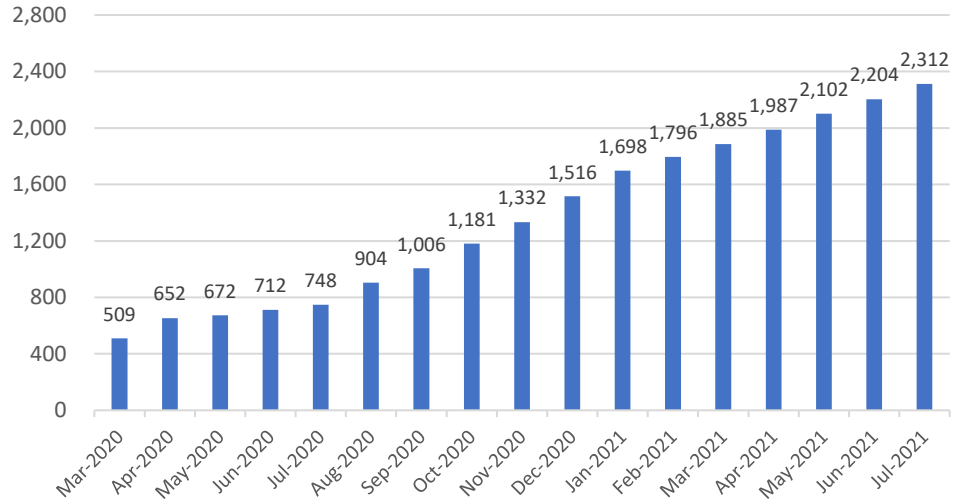

Figure 5. Cumulative COVID-19 confirmed cases in Shanghai between March 2020 and July 2021 [Data from Dong et al. (2020)]

After the first COVID-19 positive case was detected, the Shanghai municipal authority implemented a strong lockdown policy to strengthen the prevention, including temporary suspending on specific express buses, subways and railways, and intercity buses altogether. Afterward, public cultural institutions (museums, science halls, libraries, and theaters) were closed, and religious events and entertainment facilities were suspended. Until February 2020, strict restrictions on resuming work, delaying the start of school, continuing closure of public gyms, and implementing proactive policies, including quarantine rules and mandatory facemask wearing in public transits continued. (Consulate General of the Republic of Korea in Shanghai, 2020). As a result of these efforts only a single new case from local was reported between March to April 2020, and no newly confirmed cases from local were reported for 55 consecutive days from late April 2020 (Li et al., 2020).

After that, numerous shops, malls, restaurants, entertainment/leisure facilities,

clinics reopened, accompanied by social distancing rules being kept (Mayer Brown, 2020). The public health emergency response in Shanghai was downgraded to Class 3 on May 9, 2020, and most schools were reopened with the initial aid of online teaching techniques in March and April 2020 (Consulate General of the Republic of Korea in Shanghai, 2020; Shanghai Municipal People's Government, 2020a). On December 8, the government stated that all Shanghai communities would be listed as low-risk infection areas (Shanghai Municipal People's Government, 2020b).

3) Taipei

Taiwan announced its first confirmed cases on January 21, 2020. At the end of July 2021, a total of 15,674 confirmed cases with 12,856 recovered cases and 787 deaths were reported in Taiwan nationwide. Due to the absence of COVID-19 data of Taipei, this part will be discussed based on the Taiwan nationwide data. The number of confirmed cases in Taiwan per month from March 2020 to July 2021 are shown in Figure 6. The figure also covers the survey period conducted in Taipei. During the survey period, the daily average of new cases was only 3.475. The number of cases in Taipei would be presumably the same or smaller, seeing that the figure describes its nationwide cases.

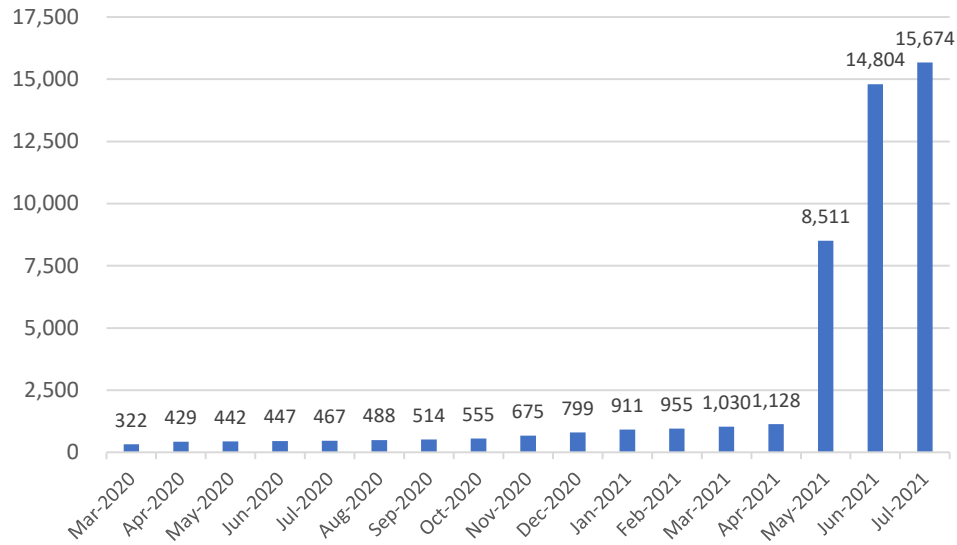

Figure 6. Cumulative COVID-19 confirmed cases in Taiwan between March 2020 and July 2021 [Data from Dong et al. (2020)]

When the first cases of COVID-19 were reported from China, the Taiwanese government quickly responded by introducing strict quarantine measures, employing health monitoring procedures, and immediately utilizing contact tracing of an infected person at its border. The region-wide earlier detection and proactive responses were considered remarkable relative to other countries (Kuo, 2021). It is believed that lessons from the 2003 SARS pandemic significantly contributed to those effective and in-time responses (Lin et al., 2020).

Regarding the use of urban spaces, social distancing measures in Taiwan were announced on April 1, 2020, to uphold social etiquette and reduce the potential risk of community transmission. The measure contains guidelines and recommendations for mass transportation, business, large-scale gatherings, large commercial sites, and many others. In July 2020, Taiwan loosened certain restrictions on social gatherings and activities, considering the low community transmission risk in the region with

no new indigenous cases. (CECC, 2020)

In summary, Taipei is one of the few cities to realize a mostly COVID-19-free daily life during the global pandemic by performing highly advanced prevention and control strategies and providing well-staffed health care resources (Ralph & Kim, 2020; Ho, 2020).

2. Data Analysis

The study aims to identify the behavior- and perception-related factors and variables on the use of urban spaces. An ordered logit model used in this study is a regression model for an ordinal response variable. Since the response variable is set as the level of urban space visits compared to before the COVID-19 outbreak, which is ordinal, employing the ordered logit model is appropriate for the given data.

In 1980, Mccullagh first described the ordered logit model and stated that the objective is to reveal structural models that suit measurements on a purely ordinal scale (Mccullagh, 1980). The ordered logit model is based on the cumulative probabilities of the response variable. The logit of each cumulative probability is presumed to be a linear function of the covariates with regression coefficients constant across response categories.（Grilli & Rampichini, 2014)

In other words, the proportional odds assumption, often referred to as the parallel regression assumption, should be met to use the model. If the assumption is held, the odds ratios would be constant across all possible category cutoffs of the dependent variable. When the proportional odds assumption is rejected, alternative models such as the generalized ordered logit model and partial proportional odds model can be

considered (Williams, 2016). However, the assumption is often violated (Liu & Koirala, 2012) and results in a rejection nearly always with a diminutive *p* value (O'Connell, 2006) due to its sensitivity to the sample size (Clogg & Shihadeh, 1994) and the number of explanatory variables (Brant, 1990). Kim (2003) also reported that the violation of the assumption does not imply its statistical inadequacy in terms of practical significance.

The ordered logit model can be defined as (1), where J is categories (level of urban space visiting) and p is predictors.

$$\text{logit}(\text{P}(\text{Y} \leq \text{j})) = \beta_{j0} + \beta_1 x_1 + \cdots + \beta_p x_p \qquad \text{j} = 1, \cdots, \text{J} - 1 \qquad (1)$$

The model has been used extensively in the medical and health field (Harrell, 2015; Nwakuya & Mmaduka, 2019). Now, it is widely used in social science, economics, transportation, and physical science research as well (Hilbe, 2009).

IV. Results

1. Descriptive Statistics

The primary data were collected from an online structured survey of adults living in the three cities: between September 23 and October 7, 2020 in Seoul Metropolitan Area, between September 8, 2020 and January 8, 2021 in Shanghai Metropolitan Area, and from October 15, 2020 to January 4, 2021 in Taipei. The survey's sample sizes are: 537 in Seoul, 398 in Shanghai, and 152 in Taipei. Random quota sampling

was employed in Seoul and Shanghai according to age and gender, and snowball sampling was applied in Taipei. The descriptive statistics of the survey respondents' characteristics are shown in Table 1.

In terms of demographic statistics in the Seoul Metropolitan Area, women accounted for 50.65% of total respondents, while men accounted for 49.35%. The distribution among the different age groups is as follows: 20.30% of respondents in their 20s or below; 34.26% in their 30s; 34.64% in their 40s; and 10.80% in their 50s or above. Married people accounted for 47.30%, and others accounted for 52.70%. Respondents with middle school (or less) degree, high school degree, college/university degree, and graduate school degree constituted 0.37%, 18.44%, 74.67%, and 6.52%, respectively.

In the Shanghai Metropolitan Area, women accounted for 59.80%, and men accounted for 40.20%. As shown in Table 1, 28.14% of the respondents were in their 20s or below, 50.75% were in their 30s, 16.83% were in their 40s, and 4.27% were in their 50s or above. Married people constitute 77.64%, while others constitute 22.36%. Respondents with middle school (or less) degree, high school degree, college/university degree, and graduate school degree constituted 0.25%, 1.76%, 82.66%, and 15.33%, respectively.

Lastly, in the case of Taipei, women accounted for 57.24% of total respondents, while men accounted for 42.76%. The distribution among the different age groups is as follows: 35.53% of respondents in their 20s or below; 19.74% in their 30s; 23.68% in their 40s; and 21.05% in their 50s or above. Married people accounted for 46.05%, and others accounted for 53.95%. Respondents with middle school (or less) degree, high school degree, college/university degree, and graduate school degree

constituted 0.00%, 2.63%, 53.29%, and 44.08%, respectively.

Table 1. Descriptive statistics of the survey respondent's characteristics

	Seoul (n=537)		**Shanghai (n=398)**		**Taipei (n=152)**	
	n	%	n	%	n	%
Age group						
20s or below	109	20.30	112	28.14	54	35.53
30s	184	34.26	202	50.75	30	19.74
40s	186	34.64	67	16.83	36	23.68
50s or above	58	10.80	17	4.27	32	21.05
Gender						
Female	272	50.65	238	59.80	87	57.24
Male	265	49.35	160	40.20	65	42.76
Marital status						
Married	254	47.30	309	77.64	70	46.05
Others	283	52.70	89	22.36	82	53.95
Education						
Middle school or less	2	0.37	1	0.25	0	0.00
High school	99	18.44	7	1.76	4	2.63
College/University	401	74.67	329	82.66	81	53.29
Graduate school	35	6.52	61	15.33	67	44.08
Monthly household income (KRW)					Annual household income (KRW)	
< 100k	15	2.80	9	2.26	< 4,000k	
					70	46.05
100k – less than 300k	92	17.13	117	29.40	4,000k-8,000k	
					50	32.90
300k–less than 500k	180	33.52	153	38.44	8,000k-12,000k	
					19	12.50
500k–less than 700k	137	25.51	82	20.60	12,000k-16,000k	
					5	3.29
700k–less than 900k	71	13.22	16	4.02	16,000k-20,000k	
					4	2.63
>= 900k	42	7.83	21	5.28	>= 20,000k	
					4	2.63

1) Descriptive Statistics of the Survey Results

As the dependent variable, a question asking “How often do you currently visit the following urban spaces compared to before the COVID-19 outbreak?” was used. The variable was measured at an 11-point Likert-type *rating* scale: 1 = a significant decrease in visits; 6= same as before the COVID-19 outbreak; 11= a significant increase in visits. Respondents were asked to self-report the changes in visits to 14 different urban spaces compared to before the outbreak of COVID-19. For the data collected in Shanghai, 346 out of the 398 responses were put into analysis due to missing values.

As independent variables, questions related to the use of urban spaces were extracted based on the literature review. Table 2 presents the descriptive statistics of the questions. Survey questions that directly or indirectly asked about visits to urban spaces (concerning visits to, for example, medical facilities for getting treatment, parks, public squares, and other multi-use facilities) were excluded from the analysis.

Table 2. Descriptive statistics of survey questions

Questions	Measurement	Seoul		Shanghai		Taipei	
		Mean	SD	Mean	SD	Mean	SD
A-1. Postponed or canceled trips to the out-of-city area[1)]	1=Never; 5=Very frequently	2.839	1.564	2.361	1.129	2.164	1.334
A-2. Postponed or not attended school/work/local events[1)]		2.875	1.512	2.170	1.048	2.125	1.303
A-3. Postponed or canceled personal/social activities[1)]		3.424	1.363	2.511	1.069	2.414	1.349
A-4. Refrained from going out for eating out and leisure and spent time at home[1)]		3.951	1.101	2.763	1.047	2.921	1.425
A-5. Worked or studied at home[1)]		2.849	1.489	2.543	1.129	1.953	1.278
A-6. Worn face mask when attending any kind of event[1)]		3.929	1.422	3.433	0.856	4.467	0.813
A-7. Stayed at home and kept social distancing rules except for working, emergency situations, and going to school[1)]		4.132	1.061	3.150	0.932	3.789	1.064
A-8. Not attended gatherings of more than ten people (e.g., social gatherings, watching sports games, watching movies, religious events, etc.) [1)]		3.916	1.359	2.768	1.026	2.802	1.223
Risk perception of COVID-19[2)]	1=Not at all worried; 11=Extremely worried	9.694	1.489	6.213	2.168	7.493	2.557
The perceived safety in the city toward COVID-19[3)]	1=Very unsafe; 5=Very safe	2.476	0.868	3.690	0.864	3.493	0.983

[1)] How often have you taken the following actions to prevent infection of COVID-19 for the last week?

[2)] How much are you worried about COVID-19?

[3)] How much do you think the city you are living in is safe from COVID-19?

2) Internal Consistency Using Cronbach's Alpha

In this section, this study uses Cronbach's alpha to assess the internal consistency of a set of questions. Cronbach's alpha is used to evaluate the internal consistency of several questions and stands for how closely related a set of questions are as a group. As a measure of internal consistency, Cronbach's alpha is also believed to be a measure of scale reliability (Gold et al., 2013), ranging from 0 to 1.0. A higher coefficient indicates higher reliability of the instrument (Zimpel et al., 2019). Cronbach's alpha of 0.6 or higher is a generally acceptable level of reliability (Ursachi et al., 2015; van Griethuijsen et al., 2015; Taber, 2018).

As displayed in Table 3, Question A-1 through A-4 points to avoiding leisure or trips and refraining from participating in social activities or events. Question A-5 through A-8 contains working or studying at home, wearing facemasks, and following social distancing rules. For assessing the internal consistency of the classified set of questions, Cronbach's alpha was calculated (see Table 3 and Table 4).

As shown in Table 3, the Cronbach's alpha of Question A-1 through A-4 is above 0.7 in all cities. The alpha tends to increase when excluding Question A-4 (refrained from going out for eating out and leisure and spent time at home), yet remains above 0.6 when the question is included as it is. Thus, the question was not deleted from the list. The study will now name the questions from Question A-1 to Question A-4 as a variable called "Refraining from leisure or social activities".

Table 3. Internal consistency of the question from A-1 to A-4

Deleted Variable	**Seoul**		**Shanghai**		**Taipei**	
	Corr. with Total	Alpha	Corr. with Total	Alpha	Corr. with Total	Alpha
A-1. Postponed or canceled trips to the out-of-city area	0.622	0.692	0.681	0.676	0.634	0.672
A-2. Postponed or not attended school/work/local events	0.679	0.657	0.639	0.701	0.650	0.664
A-3. Postponed or canceled personal/social activities	0.674	0.665	0.652	0.693	0.679	0.645
A-4. Refrained from going out for eating out and leisure and spent time at home	0.346	0.815	0.390	0.821	0.334	0.831
Total	$\alpha = 0.772$		$\alpha = 0.781$		$\alpha = 0.765$	

Table 4 shows the Cronbach's alpha of Question A-5 through A-8 in all cities. For Taipei, the internal consistency dropped significantly to 0.472 when Question A-5 (worked or studied at home) is included. In the other two cities, the elimination of Question A-5 increased each value of alpha, indicating improved internal consistency among the remaining items. Deletion of Question A-5 resulted in a reliable value of alpha (0.614); therefore, the question was deleted for further analysis. This study will now name the set of questions from Question A-6 to Question A-8 as a variable called "Compliance with preventive measures".

Table 4. Internal consistency of the question from A-5 to A-8

Deleted Variable	**Seoul**		**Shanghai**		**Taipei**	
	Corr. with Total	Alpha	Corr. with Total	Alpha	Corr. with Total	Alpha
A-5. Worked or studied at home	0.232	0.682	0.368	0.675	0.068	0.614
A-6. Worn face mask when attending any kind of event	0.427	0.525	0.459	0.608	0.320	0.381
A-7. Stayed at home and kept social distancing rules except for working, emergency situations, and going to school	0.522	0.486	0.532	0.557	0.404	0.283
A-8. Not attended gatherings of more than ten people (e.g., social gatherings, watching sports games, watching movies, religious events, etc.)	0.474	0.490	0.485	0.585	0.373	0.288
Total	$\alpha = 0.618$		$\alpha = 0.672$		$\alpha = 0.472$	

In the following analysis, these two factors, which are named as “Refraining from leisure or social activities” and “Compliance with preventive measures”, are put into the model, as well as the risk perception of COVID-19 and perceived safety in the city that has been addressed in the literature review.

As previously discussed, 14 urban spaces surveyed in this study are grouped into three types of urban spaces. According to Anggraini (2009), Anggraini et al. (2017), and Vovsha et al. (2004), activities can be categorized into three groups: mandatory, maintenance, and discretionary. Mandatory activities include going to work or school. Maintenance activities refer to pursuits such as shopping, banking, seeing a doctor, raising children, eating, and hygiene maintenance. Lastly, discretionary activities refer to leisure and entertainment activities, social activities, sports, dining out, taking up hobbies, and volunteering (Chen & Mokhtarian, 2006). Maintenance activity and discretionary activity can also be grouped as non-mandatory activity (Anggraini, 2009). [2]

[2] The urban spaces and facilities included in this study are classified based on the proposed activity type. Work facilities (e.g., workplaces and schools) are spaces where mandatory activities are performed. Medical facilities (e.g., hospitals and pharmacies), shopping centers (e.g., shopping complexes, department stores, and markets), financial facilities, public bathhouses, saunas, and dry saunas, and public service facilities (e.g., public offices, public health centers, and public libraries), are classified as spaces where maintenance activities are carried out. In contrast, eateries (restaurants and cafés), nightlife facilities (e.g., pubs, clubs, amusement arcades, and karaoke rooms), cultural facilities (e.g., art museums, concert halls, and movie theaters), indoor sports facilities (e.g., gyms, swimming pools, and bowling alleys), outdoor sports facilities (e.g., football pitches and tennis courts), religious facilities, open spaces (e.g., parks and playing fields), and green spaces (e.g., mountains, seas, and rivers) are categorized as spaces where discretionary activities are performed. (see Appendix 1)

The study calculates Cronbach's alpha of each type of space to validate the urban space classification. With the exception of the space for mandatory activity, which consisted of only one type of space (work facilities), the values of Cronbach's alpha for maintenance and discretionary activity space in three cities are as shown as follows (see Table 5). All values are 0.7 or higher, showing a relatively high level of reliability (Taber, 2018).

Table 5. Cronbach's alpha of each type of urban space according to the classification

	Space for maintenance activity	**Space for discretionary activity**
Seoul	0.774	0.838
Shanghai	0.917	0.933
Taipei	0.890	0.872

2. Ordered Logit Models

1) Seoul

An ordered logit model was then performed using SAS. Table 6 shows the result of the ordered logit model in Seoul.

Behavior- and perception-related factors or variables that commonly influence the use of all types of urban space in the Seoul Metropolitan Area include the refraining from leisure or social activities (-) and risk perception of COVID-19 (-) (see Table 6). The minus sign after the factor name means that urban space visits decrease as people are more likely to avoid leisure or social activities and perceive a higher risk of the disease. Refraining from leisure or social activities affects the decrease in the

use of all types of spaces, including mandatory, maintenance, and discretionary activity space. The result shows that the more people desist from having leisure time outside and participating in social events, the less likely they were to visit all of those spaces. Required cancellation of public events and restriction of public gatherings of fewer than ten people were executed during the study period (Hale et al., 2021). This might also affect people's leisure or social activities, eventually reducing the use of all types of urban spaces.

Also, the perceived risk of COVID-19 appears to have a significant impact on the decline in urban space visits in all urban spaces. The study found that the higher the risk perception of COVID-19, the lower the use of all types of urban spaces in the city. Arguably, the result can be supported by the prior knowledge that perceived risk of infectious disease affected people's behavior and caused people to avoid crowded places as part of protective health behavior (Leppin & Aro, 2009; Yildirim et al., 2020; Wise et al., 2020).

A variable that partly influences the use of certain types of urban spaces contains the perceived safety in the city toward COVID-19 (+). The plus sign after the factor name signifies that urban space visits increase when people consider the city as safe from the COVID-19. It turned out that the more people perceive their city to be safe from COVID-19, the more likely they are to visit maintenance and discretionary activity spaces. This can be interpreted as a result consistent with prior studies that higher safety awareness of the city increases people's outdoor physical activity (Evenson et al., 2012). Spaces for maintenance and discretionary activity can be grouped as non-mandatory activity spaces, while work facilities and schools belong to mandatory activity spaces (Anggraini, 2009). Medical facilities, shopping centers,

financial facilities, public bathhouses or saunas, public service facilities, eateries, nightlife facilities, cultural facilities, indoor sports facilities, outdoor sports facilities, religious facilities, open spaces, and green spaces are the example of the non-mandatory urban spaces.

Regarding sociodemographic variables, women turned out to reduce their visits to all types of urban spaces. Marital status and age are associated with the use of non-mandatory activity spaces. People who are not married are more likely to visit maintenance activity spaces such as medical facilities, shopping centers, financial facilities, public bathhouses and saunas, and public service facilities. As age increases, visits became fewer to discretionary activity spaces such as restaurants and cafés, nightlife, cultural facilities, religious facilities, open spaces, and green spaces. The result of the ordered logit model that had sub-classification on discretionary activity space with/without 3Cs (crowded places, close-contact settings, and confined and enclosed spaces) (WHO, n.d.) is presented in Appendices. Here, places without 3Cs only include open spaces and green spaces (see Appendix 2-1).

Table 6. Ordered logit models of the Seoul Metropolitan Area

	Space for mandatory activity		**Space for maintenance activity**		**Space for discretionary activity**	
Variable	Coefficients	Std. Error	Coefficients	Std. Error	Coefficients	Std. Error
Refraining from leisure or social activities	**-0.145** *	0.085	**-0.237** ***	0.083	**-0.177** **	0.083
Compliance with preventive measures	0.129	0.087	0.012	0.085	-0.020	0.085
Risk perception of COVID-19	**-0.147** ***	0.057	**-0.205** ***	0.054	**-0.255** ***	0.054
Perceived safety in the city toward COVID-19	0.042	0.094	**0.402** ***	0.093	**0.408** ***	0.093
Age	0.011	0.009	-0.012	0.009	**-0.024** ***	0.009
Gender (reference = male)	**-0.408** **	0.160	**-0.324** **	0.155	**-0.272** *	0.155
Marriage (reference = married)	0.209	0.193	**0.412** **	0.188	0.239	0.188
Education (reference = middle school)						
High school	0.601	1.294	0.512	1.285	-0.364	1.282
College/university	0.937	1.288	0.223	1.279	-0.679	1.276
Graduate school	1.000	1.327	0.739	1.315	-0.482	1.312
Household income	-0.000	0.000	0.000	0.000	-0.000	0.000

*: p <0.1, **: p<0.05, ***: p<0.01

2) Shanghai

Table 7 shows the result of the ordered logit models in the Shanghai Metropolitan Area. Factors or variables that commonly affect the decrease of all types of urban space visits are compliance with preventive measures (-). The Shanghai government has implemented stringent movement control and physical distancing since the COVID-19 cases were imported into the area (Consulate General of the Republic of Korea in Shanghai, 2020). The result reveals that higher conformity with the authority's preventive measure empirically reduced the use of all types of urban spaces. It is noteworthy that compliance with the policy measures still affects the reduction of urban space visits even when the coronavirus is well controlled in Shanghai. Presumably, this may be attributed to the Chinese social and political characteristics. The Chinese people have a relatively higher level of trust in their official authority than other countries (Darr, 2011), and they are known for having a sense of patriotism (Zhao, 1998).

Refraining from leisure or social activities (-) and risk perception of COVID-19 (+) was found to be the factors that affect the visits to mandatory activity space and non-mandatory activity space, respectively. Refraining from leisure or social activities is shown to affect the decrease in the use of mandatory activity spaces. Interestingly, a higher risk perception of COVID-19 is demonstrated to increase visits to non-mandatory activity spaces, consisting of maintenance and discretionary activity spaces. In the survey period from September 2020 to January 2021, only 5.161 average of daily new cases in Shanghai were reported, meaning that the coronavirus was effectively controlled. In September 2020, the Shanghai Municipal

People's Government declared that all places in Shanghai are at low risk for COVID-19 (Shanghai Municipal People's Government, 2020b). Thus, even if people perceived a high risk of perception of the epidemic, this did not necessarily lead to a reduction in urban space visits.

For the sociodemographic variables, those who were not married tend to decrease visits to all types of urban spaces compared to before the COVID-19 pandemic. Furthermore, age is associated with fewer visits to non-mandatory activity spaces. It turns out that the higher the age, the fewer people visit such spaces as restaurants, cafés, nightlife facilities, cultural facilities, religious facilities, open spaces, and green spaces. The result of the ordered logit model of the Shanghai Metropolitan Area that had sub-classification on discretionary activity space with/without 3Cs is presented in Appendices, and places without 3Cs contain open spaces and green spaces only (see Appendix 2-2).

Table 7. Ordered logit models of the Shanghai Metropolitan Area

	Space for mandatory activity		**Space for maintenance activity**		**Space for discretionary activity**	
Variable	Coefficients	Std. Error	Coefficients	Std. Error	Coefficients	Std. Error
Refraining from leisure or social activities	**-0.281** **	0.123	-0.195	0.121	-0.197	0.121
Compliance with preventive measures	**-0.317** **	0.136	**-0.638** ***	0.138	**-0.561** ***	0.137
Risk perception of COVID-19	0.038	0.045	**0.096** **	0.045	**0.099** **	0.045
Perceived safety in the city toward COVID-19	0.011	0.113	0.180	0.112	0.129	0.111
Age	-0.014	0.013	**-0.036** ***	0.013	**-0.022** *	0.013
Gender (reference = male)	-0.156	0.198	-0.307	0.197	-0.098	0.196
Marriage (reference = married)	**-0.975** ***	0.267	**-0.790** ***	0.262	**-0.806** ***	0.262
Education (reference = middle school)						
High school	1.071	1.927	-0.079	1.888	-0.671	1.889
College/university	0.118	1.819	-1.569	1.781	-2.029	1.784
Graduate school	0.030	1.833	-1.505	1.794	-1.647	1.797
Household income	0.007	0.008	0.010	0.008	0.009	0.008

*: p <0.1, **: p<0.05, ***: p<0.01

3) Taipei

Factors or variables that are involved in urban space visits of Taipei citizens are presented in Table 8. Taipei is a city where border control and preventive measures had worked highly effectively since the first case of COVID-19 in Wuhan. The daily number of new confirmed cases within the country was about 3.5 while the world suffered from the pandemic.

No factors and variables that are commonly involved in the change of visiting behavior of all types of urban space are detected in Taipei. Nevertheless, a factor named refraining from leisure or social activities (+) influences the visits to mandatory and discretionary activity space. Ironically, the more people refrained from leisure or social activities, the more they were likely to visit those spaces.

For sociodemographic variables, it is shown that those who are not married visit both mandatory and non-mandatory activity places more often than married people. In addition, in the case of space for mandatory activity, people with a higher level of education than high school graduation are found to increase visits to work facilities.

The result of the ordered logit model of Taipei that made sub-classification on discretionary activity space with/without 3Cs is presented in Appendices. Open spaces and green spaces belong to the place without 3Cs (see Appendix 2-3).

Table 8. Ordered logit models of Taipei

	Space for mandatory activity		**Space for maintenance activity**		**Space for discretionary activity**	
Variable	Coefficients	Std. Error	Coefficients	Std. Error	Coefficients	Std. Error
Refraining from leisure or social activities	**0.446** **	0.190	0.238	0.155	**0.334** **	0.158
Compliance with preventive measures	0.225	0.231	-0.077	0.192	-0.031	0.194
Risk perception of COVID-19	0.048	0.072	0.051	0.060	0.009	0.061
Perceived safety in the city toward COVID-19	-0.037	0.184	0.049	0.155	-0.003	0.156
Age	0.029	0.021	0.009	0.017	0.009	0.018
Gender (reference = male)	-0.297	0.366	-0.150	0.308	-0.166	0.311
Marriage (reference = married)	**1.015** *	0.518	**0.987** **	0.432	**0.720** *	0.434
Education (reference = high school)						
College/university	**3.316** ***	1.001	1.054	0.929	0.329	0.937
Graduate school	**3.731** ***	1.026	1.398	0.942	0.861	0.951
Household income	-0.228	0.156	-0.163	0.128	-0.152	0.130

*: p <0.1, **: p<0.05, ***: p<0.01

V. Conclusions

1. Summary and Conclusions

More than 90% of COVID-19 confirmed cases are concentrated in urban areas. As cluster infections in various multi-use facilities and spaces within the city are reported, a relevant study is urgently needed to identify the dynamics of COVID-19 in urban spaces. This study identified perception- and behavior-related factors affecting urban space visits in Seoul, Shanghai, and Taipei during the COVID-19 pandemic. The study used first-hand survey data to analyze the factors that affect visits to various spaces. The survey was conducted on adults aged 19 or older living in each city and was carried out from September to October 2020 in the Seoul Metropolitan Area, from September 2020 to January 2021 in the Shanghai Metropolitan Area, and from October 2020 to January 2021 in Taipei. The sample sizes of the survey are: 537 in Seoul, 398 in Shanghai, and 152 in Taipei.

Through literature review, variables that can affect the use of urban spaces were derived: risk perception of COVID-19, perceived safety in the city towards COVID-19, and preventive measures and policies. The study grouped multiple questions into several factors using Cronbach's alpha and put them into the ordered logit model.

In shedding light on the impact of individual's behavior- and perception-related factors on urban space visits, 14 types of urban spaces were classified into three categories (mandatory activity space, maintenance activity space, and discretionary activity space) based on previous studies. The study then performed the ordered logit model since the response variable was designed on an 11-point Likert-type *rating*

scale, asking the current level of urban space visits compared to before the COVID-19 outbreak.

According to the results, behavior- and perception-related factors and variables that commonly influence the choice of all types of urban space in Seoul include refraining from leisure or social activities and risk perception of COVID-19. The results showed that the more people desist from having leisure time outside and participating in social events, the less likely they would visit all types of urban spaces. Also, the higher the risk perception of COVID-19, the lower the use of urban spaces in the city. High perceived safety in the city was derived as a variable affecting increased visits to maintenance and discretionary activity spaces, excluding mandatory activity spaces.

In the metropolitan area of Shanghai, compliance with preventive measures was shown to reduce all types of urban space visits. It was found that refraining from leisure and social activities influenced the decrease in the use of mandatory activity space, which stands for workplace and school. In addition, unlike Seoul, the higher the risk perception of COVID-19, the increased visits to maintenance and discretionary activity space in the area.

In Taipei, no factors and variables that are involved in the change of visiting behavior of all types of urban spaces were derived. As the city is well-known for its highly advanced prevention and control strategies that lead to mostly COVID-19-free daily life during the global epidemic, it can be explained that no behavior- and perception-related factors influenced changes in visiting behavior compared to before the COVID-19. Nonetheless, the factor, refraining from leisure or social activities, influenced the increased visits to mandatory and discretionary activity

space.

Through the analysis, the study partly reaffirms the behavior- and perception-related factors presented in the prior studies. In the Seoul Metropolitan Area, which has been constantly affected by repeated spread and mitigation of COVID-19, the higher perceived risk of COVID-19 was shown to reduce visits to all types of urban spaces. It was also found that increased perception of city safety towards COVID-19 leads to an increase in visits to non-mandatory activity space.

However, the relationship was not observed equally in all cities. For example, in the metropolitan area of Shanghai, the higher the risk perception of COVID-19, the more citizens were likely to visit maintenance and discretionary activity spaces. Likewise, each city's results should be explained against the backdrop of the different experiences and policies to respond to the infectious disease. By examining both the city where COVID-19 is still prevalent and relatively well-controlled, the study derived behavior- and perception-related factors affecting urban space visiting.

Now, vaccination rollout is progressing, and 29.6% of the world's population, already got their shot (at least one dose) as of early August 2021 (Ritchie et al., 2021). As vaccinations accelerate, restrictions on urban space use will be loosened, and eventually, there will be no regulations as before COVID-19. Still, urban space use needs to be dealt with in-depth and importantly in the preventive and containment measure. The transmission risk of infectious diseases can be heightened in certain types of indoor spaces (Distasio & Trump, 1990; Li et al., 2005; Morawska et al., 2020). Therefore, it would be necessary to distinguish behavior and perception factors that affect differently depending on the type of urban space and the situation of COVID-19, and then make them reflected in establishing policy interventions.

2. Implications

As a case study, the study examined the behavior and perception factors on the visit to urban spaces in three East Asian cities. Among the three cities, one was still under the influence of COVID-19 spread, while the other two were relatively well-controlled for the infectious disease. The former is the Seoul Metropolitan Area, while the latter includes the Shanghai Metropolitan Area and Taipei.

In the Seoul Metropolitan Area case, the factors derived are supported by prior studies or duly interpreted, whereas a few opposite results have been obtained in other cities. From this conflicting but note-worthy result, this thesis suggests policy implications for cities with different COVID-19 experiences.

First of all, cities where COVID-19 mitigates and repeatedly spreads, such as Seoul, are subject to discussion. In this case, risk communication on risk perception and perceived safety in the city would play a significant role in reducing urban space visits. This study showed that higher risk perception of COVID-19 reduces visits to all types of urban spaces, while higher safety perception in the city increases visits to non-mandatory activity space. The role of governments and public agencies in risk communication influences how people perceive, understand, and expect emergencies such as the pandemic (Moreno et al., 2020). Amid the global pandemic, individuals have been exposed to much information and seeking information about COVID-19 through various channels (Moreno et al., 2020). Overwhelmed by too much information containing false or misleading information, people have received scientifically unproven fake news associated with the spread of COVID-19 (Moscadelli et al., 2020). Those who are exposed to fake news may underestimate

the government's efforts to control the spread of the virus (Apuke & Omar, 2021) and even take risks that could lead to threats against public health (Pennycook et al., 2020). Therefore, based on scientific evidence, public health authorities should carry out risk management that suitably intervenes in citizen's use of urban spaces. The interventions shall ultimately aim to mitigate infectious diseases and benefit public health.

The importance of risk communication is also emphasized in cities where COVID-19 is well-controlled. People with a high-risk perception of COVID-19 turned out to visit non-mandatory activity spaces more often in Shanghai despite possible infections. Even though the situation is fairly under control, it is needed to continue effective risk management in preparation for future waves because poor risk communication may lead to another phase of the COVID-19 pandemic (Oerther & Watson, 2020).

The limitations of this study are as follows. Firstly, this study is an exploratory study investigating the relationship between behavior- and perception-related factors and the use of urban space. Further studies are required to elucidate or test the results of the study. Besides, the study area of this research is set as three East Asian cities. Future research focused on Western contexts of urban space visits during the COVID-19 is recommend. Secondly, a few sociodemographic variables were conflicting across the type of urban space and city. The difference may stem from the actual difference of different characteristics of residents in each city; however, as described in section IV-1, Shanghai respondents in their 20s and 30s or married showed a tendency of overrepresentation. Thus, it would be preferable to minimize all possible errors in the sampling process in future studies.

Lastly, an advanced discussion on the discretionary activity space is expected. Spaces for discretionary activity are places of great concern for the spread of infectious diseases. At the same time, they are expected to have variations in the visit by time and specific kinds. Under the category of discretionary activity space, eight different types of urban spaces were grouped into one. Both nightlife facilities and green spaces are conceptually subject to be a space for discretionary activity. Yet, it would be valid to assume that the two spaces have different environments in spreading infectious diseases. Likewise, it would be meaningful to make a subdivision for the category and examine factors that affect visits to those places based on the subdivision.

References

Clogg, C. C., & Shihadeh, E. S. (1994). *Statistical models for ordinal variables* (Vol. 4). SAGE Publications.

Harrell, F. E. (2015). *Regression modeling strategies: with applications to linear models, logistic and ordinal regression, and survival analysis*. New York: springer.

Hilbe, J. M. (2009). *Logistic regression models*. Chapman and hall/CRC.

O'Connell, A. A. (2006). *Logistic regression models for ordinal response variables* (Vol. 146). SAGE Publications.

Sadik-Khan, J., & Solomonow, S. (2017). *Streetfight: Handbook for an urban revolution*. Penguin.

Asian Development Bank (ADB). (2014). Urban Metabolism of Six Asian Cities.

UN-Habitat. (2020). Public Space and COVID-19.

United Nations (UN). (2020). Policy Brief: COVID 19 in an Urban World.

Abdelrahman, M. (2020). Personality traits, risk perception, and protective behaviors of Arab residents of Qatar during the COVID-19 pandemic. *International Journal of Mental Health and Addiction*. 1-12. https://doi.org/10.1007/s11469-020-00352-7

Ahmed, F., Zviedrite, N., & Uzicanin, A. (2018). Effectiveness of workplace social distancing measures in reducing influenza transmission: a systematic review. *BMC public health, 18*(1), 1-13.

Al-Ahmadi, K., Alahmadi, S. & Al-Zahrani, A. (2019). Spatiotemporal Clustering of Middle East Respiratory Syndrome Coronavirus (MERS-CoV) Incidence in Saudi Arabia, 2012–2019. *International journal of environmental research and public health, 16*(14), s. 2520. doi:10.3390/ijerph16142520

Alexander, D., & Karger, E. (2020). *Do stay-at-home orders cause people to stay at home? Effects of stay-at-home orders on consumer behavior* (Working Paper No. 2020-12). Federal Reserve Bank of Chicago. https://www.chicagofed.org/publications/working-papers/2020/2020-12

Anggraini, R. (2009). Household activity-travel behavior: implementation of within-household interactions (Ph.D. thesis). Technical University Eindhoven, Diss. doi: 10.6100/IR657789

Anggraini, R., Sugiarto, S. & Pramanda, H. (2017). Factors affecting trip generation of motorcyclist for the purpose of non-mandatory activities. *AIP Conference Proceedings 1903*, 060011. doi:10.1063/1.5011565

Apuke, O. D., & Omar, B.. (2021). Fake news and COVID-19: modelling the predictors of fake news sharing among social media users. *Telematics and*

Informatics, 56, 101475. https://doi.org/10.1016/j.tele.2020.101475

Arthur, R. F., Gurley, E. S., Salje, H., Bloomfield, L. S. P. & Jones, J. H. (2017). Contact structure, mobility, environmental impact and behaviour: the importance of social forces to infectious disease dynamics and disease ecology. *Philosophical transactions of the royal society B: biological sciences, 372*(1719), s. 20160454. doi:10.1098/rstb.2016.0454

Baker, S. R., Farrokhnia, R. A., Meyer, S., Pagel, M., & Yannelis, C. (2020). *How does household spending respond to an epidemic? consumption during the 2020 covid-19 pandemic* (Working Paper No. 26949). National Bureau of Economic Research. https://www.nber.org/papers/w26949

Baum, F. E., Ziersch, A. M., Zhang, G., & Osborne, K.. (2009). Do perceived neighbourhood cohesion and safety contribute to neighbourhood differences in health?. *Health & Place, 15*(4), 925–934. https://doi.org/10.1016/j.healthplace.2009.02.013

Brant, R. (1990). Assessing proportionality in the proportional odds model for ordinal logistic regression. *Biometrics, 46*, 1171-1178.

Burnett, H., Olsen, J. R., Nicholls, N., & Mitchell, R.. (2021). Change in time spent visiting and experiences of green space following restrictions on movement during the COVID-19 pandemic: a nationally representative cross-sectional study of UK adults. *BMJ Open, 11*(3), e044067. https://doi.org/10.1136/bmjopen-2020-044067

Cai, J., Sun, W., Huang, J., Gamber, M., Wu, J., & He, G. (2020). Indirect Virus Transmission in Cluster of COVID-19 Cases, Wenzhou, China, 2020. *Emerging Infectious Diseases, 26*(6), 1343-1345. https://dx.doi.org/10.3201/eid2606.200412.

Chang, S., Pierson, E., Koh, P. W., Gerardin, J., Redbird, B., Grusky, D., & Leskovec, J.. (2021). Mobility network models of COVID-19 explain inequities and inform reopening. *Nature, 589*(7840), 82–87. https://doi.org/10.1038/s41586-020-2923-3

Charu, V. et al. (2017). Human mobility and the spatial transmission of influenza in the United States. *PLOS computational biology, 13*(2), s. e1005382. doi:10.1371/journal.pcbi.1005382

Chen H. Qian W. Wen Q. (2020). *The impact of the COVID-19 pandemic on consumption: Learning from high frequency transaction data* (LHA Working Paper No. 20201003). Luohan Academy. https://www.luohanacademy.com/frontiers/00d2c3eacfa38705

Chen, C. & Mokhtarian, P. L. (2006). Tradeoffs between Time Allocations to Maintenance Activities/Travel and Discretionary Activities/Travel. *Transportation, 33*(3), s. 223–240. doi:10.1007/s11116-005-2307-4

Cordes, J. & Castro, M. C. (2020). Spatial analysis of COVID-19 clusters and contextual factors in New York City. *Spatial and spatio-temporal epidemiology, 34*, 100355. doi:10.1016/j.sste.2020.100355

Corpus-Mendoza, A. N., Ruiz-Segoviano, H. S., Rodríguez-Contreras, S. F., Yañez-Dávila, D., & Hernández-Granados, A. (2021). Decrease of mobility, electricity demand, and NO2 emissions on COVID-19 times and their feedback on prevention measures. *Science of The Total Environment, 760*, 143382.

Dang, Q., Miao, R., & Yong, L. (2020). COVID-19 In Shang Hai: It is Worth Learning from the Successful Experience in Preventing and Controlling the Overseas Epidemic Situation. MedRxiv preprint. doi:10.1101/2020.05.13.20100164

Darr, B. J. (2011). Nationalism and state legitimation in contemporary China. (Ph.D. thesis). University of Iowa.

Distasio, A. J., & Trump, D. H. (1990). The investigation of a tuberculosis outbreak in the closed environment of a US Navy ship, 1987. *Military medicine, 155*(8), 347-351.

Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. *The Lancet infectious diseases, 20*(5), 533-534.

Evenson, K. R., Block, R., Roux, A. V. D., McGinn, A. P., Wen, F., & Rodríguez, D. A. (2012). Associations of adult physical activity with perceived safety and police-recorded crime: the Multi-ethnic Study of Atherosclerosis. *International journal of behavioral nutrition and physical activity, 9*(1), 1-12.

Gardner, L. M., Chughtai, A. A. & Macintyre, C. R. (2016). Risk of global spread of Middle East respiratory syndrome coronavirus (MERS-CoV) via the air transport network. *Journal of travel medicine, 23*(6), s. taw063. doi:10.1093/jtm/taw063

Gold, C., Rolvsjord, R., Mössler, K., & Stige, B. (2013). Reliability and validity of a scale to measure interest in music among clients in mental health care. *Psychology of Music, 41*(5), 665-682.

Grilli, L., & Rampichini, C. (2014). Ordered logit model. *Encyclopedia of quality of life and well-being research*, 4510-4513. doi:10.1007/978-94-007-0753-5_2023

Hale, T., Angrist, N., Goldszmidt, R., Kira, B., Petherick, A., Phillips, T., Webster, S., Cameron-Blake, E., Hallas, L., Majumdar, S., & Tatlow, H.. (2021). A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). *Nature Human Behaviour, 5*(4), 529–538.

https://doi.org/10.1038/s41562-021-01079-8

Honey-Rosés, J., Anguelovski, I., Chireh, V. K., Daher, C., Konijnendijk Van Den Bosch, C., Litt, J. S., Mawani, V., Mccall, M. K., Orellana, A., Oscilowicz, E., Sánchez, U., Senbel, M., Tan, X., Villagomez, E., Zapata, O., & Nieuwenhuijsen, M. J.. (2020). The impact of COVID-19 on public space: an early review of the emerging questions – design, perceptions and inequities. *Cities & Health*, 1–17. https://doi.org/10.1080/23748834.2020.1780074

Hsiang, S., Allen, D., Annan-Phan, S., Bell, K., Bolliger, I., Chong, T., ... & Wu, T. (2020). The effect of large-scale anti-contagion policies on the COVID-19 pandemic. *Nature, 584*(7820), 262-267.

Jalaladdini, S., & Oktay, D.. (2012). Urban Public Spaces and Vitality: A Socio-Spatial Analysis in the Streets of Cypriot Towns. *Procedia - Social and Behavioral Sciences, 35*, 664–674. https://doi.org/10.1016/j.sbspro.2012.02.135

Jang, S., Han, S. H., & Rhee, J. Y. (2020). Cluster of coronavirus disease associated with fitness dance classes, South Korea. *Emerging infectious diseases, 26*(8), 1917.

Jílková, P., & Králová, P.. (2021). Digital Consumer Behaviour and eCommerce Trends during the COVID-19 Crisis. *International Advances in Economic Research, 27*(1), 83–85. https://doi.org/10.1007/s11294-021-09817-4

Jones, H., Neal, S., Mohan, G., Connell, K., Cochrane, A., & Bennett, K. (2015). Urban multiculture and everyday encounters in semi-public, franchised cafe spaces. *The Sociological Review, 63*(3), 644-661.

Katz, R., May, L., Sanza, M., Johnston, L. & Petinaux, B. (2012). H1N1 Preventive Health Behaviors in a University Setting. *Journal of American College Health, 60*(1), s. 46–56. doi:10.1080/07448481.2011.570398

Kim, E.-A. (2020). Social Distancing and Public Health Guidelines at Workplaces in Korea: Responses to Coronavirus Disease-19. *Safety and health at work, 11*(3), s. 275–283. doi:10.1016/j.shaw.2020.07.006

Kim, J. H. (2003). Assessing practical significance of the proportional odds assumption. *Statistics & probability letters, 65*(3), 233-239.

Kowalski, R. M., & Black, K. J.. (2021). Protection Motivation and the COVID-19 Virus. *Health Communication, 36*(1), 15–22. https://doi.org/10.1080/10410236.2020.1847448

Kuebart, A. & Stabler, M. (2020). Infectious Diseases as Socio-Spatial Processes: The COVID-19 Outbreak In Germany. *Tijdschrift voor economische en sociale geografie, 111*(3), s. 482–496. doi:10.1111/tesg.12429

Kuo, C.-C.. (2021). COVID-19 in Taiwan: Economic Impacts and Lessons

Learned. *Asian Economic Papers, 20*(2), 98–117. https://doi.org/10.1162/asep_a_00805

Lee, M., Zhao, J., Sun, Q., Pan, Y., Zhou, W., Xiong, C., & Zhang, L. (2020). Human mobility trends during the early stage of the COVID-19 pandemic in the United States. *PLoS One, 15*(11), e0241468.

Lenhart, C. M., Wiemken, A., Hanlon, A., Perkett, M., & Patterson, F. (2017). Perceived neighborhood safety related to physical activity but not recreational screen-based sedentary behavior in adolescents. *BMC public health, 17*(1), 1-9.

Leppin, A. & Aro, A. R. (2009). Risk Perceptions Related to SARS and Avian Influenza: Theoretical Foundations of Current Empirical Research. *International journal of behavioral medicine, 16*(1), s. 7–29. doi:10.1007/s12529-008-9002-8

Li, X., Liu, M., Zhou, R., Zhang, Y., Wu, C., & Xu, L.. (2020). Centralized medical quarantine for imported COVID-19 in Shanghai, China. *Journal of Travel Medicine, 27*(5). https://doi.org/10.1093/jtm/taaa109

Li, Y., Huang, X., Yu, I. T. S., Wong, T. W. & Qian, H. (2005). Role of air distribution in SARS transmission during the largest nosocomial outbreak in Hong Kong. *Indoor air, 15*(2), s. 83–95. doi:10.1111/j.1600-0668.2004.00317.x

Lin, C., Braund, W. E., Auerbach, J., Chou, J.-H., Teng, J.-H., Tu, P., & Mullen, J.. (2020). Policy Decisions and Use of Information Technology to Fight Coronavirus Disease, Taiwan. *Emerging Infectious Diseases, 26*(7), 1506–1512. https://doi.org/10.3201/eid2607.200574

Liu, T., Gong, D., Xiao, J., Hu, J., He, G., Rong, Z., Ma, W. (2020). Cluster infections play important roles in the rapid evolution of COVID-19 transmission: A systematic review. *International journal of infectious diseases, 99*, s. 374–380. doi:10.1016/j.ijid.2020.07.073

Liu, X., & Koirala, H. (2012). Ordinal regression analysis: Using generalized ordinal logistic regression models to estimate educational data. *Journal of modern Applied Statistical methods, 11*(1), 21.

Martínez, L., & Short, J. R. (2021). The Pandemic City: Urban Issues in the Time of COVID-19. *Sustainability, 13*(6), 3295.

Mccullagh, P.. (1980). Regression Models for Ordinal Data. *Journal of the Royal Statistical Society: Series B (methodological), 42*(2), 109–127. https://doi.org/10.1111/j.2517-6161.1980.tb01109.x

Meng, B., Wang, J., Liu, J., Wu, J. & Zhong, E. (2005). Understanding the spatial diffusion process of severe acute respiratory syndrome in Beijing. *Public health, 119*(12), s. 1080–1087. doi:10.1016/j.puhe.2005.02.003

Morawska, L., Tang, J.W., Bahnfleth, W., Bluyssen, P.M., Boerstra, A., Buonanno, G., Cao, J., Dancer, S., Floto, A., Franchimon, F., Haworth, C., Hogeling, J., Isaxon, C., Jimenez, J.L., Kurnitski, J., Li, Y., Loomans, M., Marks, G., Marr, L.C., Mazzarella, L. et al. (2020). How can airborne transmission of COVID-19 indoors be minimised?. *Environment international, 142*, s. 105832. doi:10.1016/j.envint.2020.105832

Moreno, A., Fuentes-Lara, C., & Navarro, C.. (2020). Covid-19 communication management in Spain: Exploring the effect of information-seeking behavior and message reception in public's evaluation. *El Profesional De La Información, 29*(4). https://doi.org/10.3145/epi.2020.jul.02

Moscadelli, A., Albora, G., Biamonte, M.A., Giorgetti, D., Innocenzio, M., Paoli, S., Lorini, C., Bonanni, P., Bonaccorsi, G.. (2020). Fake News and Covid-19 in Italy: Results of a Quantitative Observational Study. *International Journal of Environmental Research and Public Health 17*, 5850. doi:10.3390/ijerph17165850

Nwakuya, M. T., & Mmaduka, O. (2019). Ordered logistic regression on the mental health of undergraduate students. *International Journal of Probability and Statistics, 8*(1), 14-18.

Oerther, D. B., & Watson, R.. (2020). Risk Communication is Important for Environmental Engineering during COVID-19. *Journal of Environmental Engineering, 146*(10), 01820002. https://doi.org/10.1061/(asce)ee.1943-7870.0001796

Oyeyemi, A. L., Adegoke, B. O., Sallis, J. F., Oyeyemi, A. Y., & De Bourdeaudhuij, I. (2012). Perceived crime and traffic safety is related to physical activity among adults in Nigeria. *BMC public health, 12*(1), 1-11.

Papadopoulos, D. I., Donkov, I., Charitopoulos, K., & Bishara, S. (2020). The impact of lockdown measures on COVID-19: a worldwide comparison. MedRxiv preprint. doi:10.1101/2020.05.22.20106476

Pennycook, G., Mcphetres, J., Zhang, Y., Lu, J.G., Rand, D.G. (2020). Fighting COVID-19 Misinformation on Social Media: Experimental Evidence for a Scalable Accuracy-Nudge Intervention. *Psychological Science 31*, 770–780.. doi:10.1177/0956797620939054

Poom, A., Järv, O., Zook, M. & Toivonen, T. (2020). COVID-19 is spatial: Ensuring that mobile Big Data is used for social good. *Big data & society, 7*(2), s. 205395172095208. doi:10.1177/2053951720952088

Qian, H., Li, Y., Nielsen, P. V., & Huang, X. (2009). Spatial distribution of infection risk of SARS transmission in a hospital ward. *Building and Environment, 44*(8), 1651-1658.

Richter, A. (2020). Locked-down digital work. *International Journal of*

Information Management, 55, 102157. https://doi.org/10.1016/j.ijinfomgt.2020.102157

Rogers, R. W. (1975). *A protection motivation theory of fear appeals and attitude change1. The journal of psychology, 91*(1), 93-114. https://doi.org/10.1080/00223980.1975.9915803

Sadique, M.Z., Edmunds, W.J., Smith, R.D., Meerding, W.J., De Zwart, O., Brug, J., Beutels, P. (2007). Precautionary Behavior in Response to Perceived Threat of Pandemic Influenza. *Emerging infectious diseases, 13*(9), s. 1307–1313. doi:10.3201/eid1309.070372

Salama, A. M. (2020). Coronavirus questions that will not go away: interrogating urban and socio-spatial implications of COVID-19 measures. *Emerald open research, 2*, s. 14. doi:10.35241/emeraldopenres.13561.1

Sendi, R., & Goličnik Marušić, B.. (2012). Neighbourhood Design. *International Encyclopedia of Housing and Home.* 21–28. https://doi.org/10.1016/b978-0-08-047163-1.00541-5

Serdoura F., & Ribeiro J.. (2007). *Public space, place of urban life*. International Conference on New Concepts and Approaches for Urban and Regional Policy and Planning?. Leuven, Belgium.

Sharifi, A., & Khavarian Garmsir, A. R. (2020). The COVID 19 pandemic: Impacts on cities and major lessons for urban planning, design, and management. *Science of The Total Environment, 749*, 142391. https://doi.org/10.1016/j.scitotenv.2020.142391

Shawket, I. M., & El Khateeb, S.. (2020). *Redefining Urban Public Space's Characters after COVID-19; : Empirical Study on Egyptian Residential Spaces*. 24th International Conference Information Visualisation (IV). https://doi.org/10.1109/iv51561.2020.00107

Shim, E., Tariq, A., & Chowell, G.. (2021). Spatial variability in reproduction number and doubling time across two waves of the COVID-19 pandemic in South Korea, February to July, 2020. *International Journal of Infectious Diseases, 102*, 1–9. https://doi.org/10.1016/j.ijid.2020.10.007

Smith, C. D., & Mennis, J. (2020). Incorporating Geographic Information Science and Technology in Response to the COVID-19 Pandemic. *Preventing Chronic Disease, 17*, E58. https://doi.org/10.5888/pcd17.200246

Sun, C., & Zhai, Z. (2020). The efficacy of social distance and ventilation effectiveness in preventing COVID-19 transmission. *Sustainable cities and society, 62*, 102390. https://doi.org/10.1016/j.scs.2020.102390

Taber, K. S. (2018). The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Research in science education, 48*(6), s. 1273–1296. doi:10.1007/s11165-016-9602-2

Tappe, K. A., Glanz, K., Sallis, J. F., Zhou, C., & Saelens, B. E.. (2013). Children's physical activity and parents' perception of the neighborhood environment: neighborhood impact on kids study. *International Journal of Behavioral Nutrition and Physical Activity, 10*(1), 39. https://doi.org/10.1186/1479-5868-10-39

Ursachi, G., Horodnic, I. A., & Zait, A. (2015). How reliable are measurement scales? External factors with indirect influence on reliability estimators. *Procedia Economics and Finance, 20*, 679-686.

Van Griethuijsen, R.A.L.F., Van Eijck, M.W., Haste, H., Den Brok, P.J., Skinner, N.C., Mansour, N., Savran Gencer, A., Boujaoude, S. (2015). Global Patterns in Students' Views of Science and Interest in Science. *Research in science education, 45*(4), s. 581–603. doi:10.1007/s11165-014-9438-6

Venter, Z. S., Barton, D. N., Gundersen, V., Figari, H., & Nowell, M.. (2020). Urban nature in a time of crisis: recreational use of green space increases during the COVID-19 outbreak in Oslo, Norway. *Environmental Research Letters, 15*(10), 104075. https://doi.org/10.1088/1748-9326/abb396

Vovsha, P., Petersen, E. & Donnelly, R. (2004). Model for Allocation of Maintenance Activities to Household Members. *Transportation research record: journal of the transportation research board, 1894* (1), s. 170–179. doi:10.3141/1894-18

Wang, C. J., Ng, C. Y., & Brook, R. H.. (2020b). Response to COVID-19 in Taiwan. *Journal of American Medical Association, 323*(14), 1341. https://doi.org/10.1001/jama.2020.3151

Wang, C., Liu, L., Hao, X., Guo, H., Wang, Q., Huang, J., ... & Wu, T. (2020a). Evolving epidemiology and impact of non-pharmaceutical interventions on the outbreak of coronavirus disease 2019 in Wuhan, China. MedRxiv preprint. doi:10.1101/2020.03.03.20030593

Wang, F., Wei, J., & Shi, X. (2018). Compliance with recommended protective actions during an H7N9 emergency: a risk perception perspective. *Disasters, 42*(2), 207-232.

Webster, C. (2007). Property rights, public space and urban design. *The Town planning review*, 81-101. https://doi.org/10.3828/tpr.78.1.6

Wei, W. E., Li, Z., Chiew, C. J., Yong, S. E., Toh, M. P., & Lee, V. J. (2020). Presymptomatic Transmission of SARS-CoV-2—Singapore, January 23–March 16, 2020. *Morbidity and Mortality Weekly Report, 69*(14), 411.

Wei, X.-S., Wang, X.-R., Zhang, J.-C., Yang, W.-B., Ma, W.-L., Yang, B.-H., Jiang, N.-C., Gao, Z.-C., Shi, H.-Z., & Zhou, Q.. (2021). A cluster of health care workers with COVID-19 pneumonia caused by SARS-CoV-2. *Journal of Microbiology, Immunology and Infection, 54*(1), 54–60.

https://doi.org/10.1016/j.jmii.2020.04.013
Williams, R.. (2016). Understanding and interpreting generalized ordered logit models. *The Journal of Mathematical Sociology, 40*(1), 7–20. https://doi.org/10.1080/0022250x.2015.1112384
Wise, T., Zbozinek, T. D., Michelini, G., Hagan, C. C., & Mobbs, D.. (2020). Changes in risk perception and self-reported protective behaviour during the first week of the COVID-19 pandemic in the United States. *Royal Society Open Science, 7*(9), 200742. https://doi.org/10.1098/rsos.200742
Yildirim, M., Geçer, E. & Akgül, Ö. (2020). The impacts of vulnerability, perceived risk, and fear on preventive behaviours against COVID-19. *Psychology, health & medicine, 26*(1), s. 35–43. doi:10.1080/13548506.2020.1776891
Zhang, X., Wang, F., Zhu, C. & Wang, Z. (2019). Willingness to Self-Isolate When Facing a Pandemic Risk: Model, Empirical Test, and Policy Recommendations. *International journal of environmental research and public health, 17*(1), s. 197. doi:10.3390/ijerph17010197
Zhao, S. (1998). A state-led nationalism: The patriotic education campaign in post-Tiananmen China. *Communist and post-communist studies, 31*(3), 287-302.
Ziersch, A. M., Baum, F. E., Macdougall, C., & Putland, C.. (2005). Neighbourhood life and social capital: the implications for health. *Social Science & Medicine, 60*(1), 71–86. https://doi.org/10.1016/j.socscimed.2004.04.027
Zimpel, R. R., Panzini, R. G., Bandeira, D. R., Fleck, M. P., & da Rocha, N. S. (2019). Psychometric properties of the WHOQOL-SRPB BREF, Brazilian Portuguese version. *Brazilian Journal of Psychiatry, 41*(5), 411-418.
Boxer, B. (2019). Shanghai. Encyclopedia Britannica. https://www.britannica.com/place/Shanghai
Centers for Disease Control and Prevention (CDC). (2020). COVID-19 Overview and Infection Prevention and Control Priorities in non-US Healthcare Settings. https://www.cdc.gov/coronavirus/2019-ncov/hcp/non-us-settings/overview/index.html
Central Epidemic Command Center (CECC). (2020). Prevention and Control of COVID-19 in Taiwan. https://www.cdc.gov.tw/En/Category/Page/0vq8rsAob_9HCi5GQ5jH1Q
Consulate General of the Republic of Korea in Shanghai. (2020). No title (all notices posted related to the relevant COVID-19 measures on the list). https://overseas.mofa.go.kr/cn-shanghai-ko/brd/m_514/list.do
European Centre for Disease Prevention and Control (ECDC). (2020). COVID-

19 clusters and outbreaks in occupational settings in the EU/EEA and the UK. https://www.ecdc.europa.eu/en/publications-data/covid-19-clusters-and-outbreaks-occupational-settings-eueea-and-uk

Google LLC. (2021). Google COVID-19 Community Mobility Reports. https://www.google.com/covid19/mobility/

International Monetary Fund (IMF). (2020). Policy responses to COVID-19. https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19

Johns Hopkins University Center for Systems Science and Engineering (JHU CSSE). (2020). COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU). https://coronavirus.jhu.edu/map.html

Korea Disease Control and Prevention Agency (KDCA). (2020a). Measures for Major Facility Activities (in Korean). http://ncov.mohw.go.kr/socdisBoardList.do?brdId=6&brdGubun=65&dataGubun=651

Korea Disease Control and Prevention Agency (KDCA). (2020b). Korean Central Disaster and Safety Countermeasures Headquarters COVID-19 Regular Briefing (9/12) (in Korean). http://ncov.mohw.go.kr/tcmBoardView.do?brdId=&brdGubun=&dataGubun=&ncvContSeq=361552&contSeq=361552&board_id=140&gubun=BDJ

Korea Disease Control and Prevention Agency (KDCA). (2020c). Overview of Social Distancing System. http://ncov.mohw.go.kr/en/socdisBoardView.do?brdId=19&brdGubun=191&dataGubun=191&ncvContSeq=&contSeq=&board_id=

Mayer Brown. (2020). The China Experience – Understanding the Evolution of the COVID-19 Crisis (Updated on 6 April, 2020). https://www.mayerbrown.com/en/perspectives-events/publications/2020/04/the-china-experience-understanding-the-evolution-of-the-covid-19-crisis-updated-on-6-april-2020

Ministry of Health and Welfare (MOHW). (2020). Korean Central Disaster and Safety Countermeasures Headquarters COVID-19 Regular Briefing (11/10) (in Korean). http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page=1&CONT_SEQ=360241

Ministry of Housing, Communities & Local Government (MHCLG). (2021). COVID-19: Guidance for the safe use of multi-purpose community facilities. https://www.gov.uk/government/publications/covid-19-

guidance-for-the-safe-use-of-multi-purpose-community-facilities/covid-19-guidance-for-the-safe-use-of-multi-purpose-community-facilities

Organization for Economic Co-operation and Development (OECD). (2020). The territorial impact of COVID-19: Managing the crisis across levels of government. https://www.oecd.org/coronavirus/policy-responses/the-territorial-impact-of-covid-19-managing-the-crisis-across-levels-of-government-d3e314e1/

Ritchie, H., Ortiz-Ospina, E., Beltekian, D., Mathieu, E., Hasell, J., Macdonald, B., ... & Roser, M. (2021). Coronavirus pandemic (COVID-19). https://ourworldindata.org/covid-vaccinations

Shanghai Municipal People's Government. (2020a). Press Release on May 8. https://www.shanghai.gov.cn/nw48572/20200826/0001-48572_129145.html

Shanghai Municipal People's Government. (2020b). All communities in Shanghai now low-risk zones. https://www.shanghai.gov.cn/nw48081/20201208/3d9adbe2c0354314b987348a29643569.html

Statistical Geographic Information Service Plus (SGIS Plus). (2021). COVID-19 Statistics. https://sgis.kostat.go.kr/view/thematicMap/thematicMapMain?stat_thema_map_id=sAXkcVzk5V202007141335257355ued9032uw&theme=CTGR_005&mapType=05

Taipei City Government. (2019). Taipei City Statistical Abstract 2018. https://dbaseng.gov.taipei/News.aspx?n=E81F1089F0AF395D&sms=947A24844A483616

United Nations (UN). (2018). World Urbanization Prospects. https://population.un.org/wup/

World Health Organization (WHO). (n.d.). COVID-19 infographics: Avoid the Three Cs. https://www.who.int/brunei/news/infographics---english

Ho, S.. (2020, December 31). *Yes, millions of people are living a relatively normal, coronavirus-free life*. CTV News. https://www.ctvnews.ca/health/coronavirus/yes-millions-of-people-are-living-a-relatively-normal-coronavirus-free-life-1.5249917

Ralph J., & Kim H. (2020, November 21). *No lockdowns, no downturn: Taiwan attracts skilled expats with (mostly) COVID-19-free life*. USA Today. https://www.usatoday.com/story/news/world/2020/11/21/taiwans-relatively-covid-free-life-attracts-skilled-expats/6322040002/

Appendices

1. Classification of urban spaces depending on the activity type

	Spaces for mandatory activity	Spaces for maintenance activity	Spaces for discretionary activity
Definition	Going to work or school	Pursuit such as shopping, banking, seeing a doctor, raising children, eating, and hygiene maintenance	Leisure and entertainment activities, social activities, sports, dining out, taking up hobbies, and volunteering
Classification of urban spaces	- work facilities (e.g., workplaces and schools)	- medical facilities (e.g., hospitals and pharmacies) - commercial centers (e.g., shopping complexes, department stores, and markets) - financial facilities - public bathhouses, saunas, and dry saunas - public service facilities (e.g., public offices, public health centers, and public libraries)	- eateries (restaurants and cafés) - nightlife facilities (e.g., pubs, clubs, amusement arcades, and karaoke rooms) - cultural facilities (e.g., art museums, concert halls, and movie theaters) - indoor sports facilities (e.g., gyms, swimming pools, and bowling alleys) - outdoor sports facilities (e.g., football pitches and tennis courts) - religious facilities - open spaces (e.g., parks and playing fields) - green spaces (e.g., mountains, seas, and rivers)

2-1. Ordered logit models of discretionary activity spaces with/without 3Cs, Seoul Metropolitan Area[†]

	Space for discretionary activity			
	Spaces without 3Cs		**Spaces with 3Cs**	
Variable	Coefficients	Std. Error	Coefficients	Std. Error
Refraining from leisure or social activities	-0.123	0.082	**-0.232** ***	0.084
Compliance with preventive measures	0.042	0.084	-0.039	0.086
Risk perception of COVID-19	**-0.295** ***	0.054	**-0.232** ***	0.054
Perceived safety in the city toward COVID-19	**0.300** ***	0.091	**0.296** ***	0.093
Age	**-0.022** **	0.009	**-0.016** *	0.009
Gender (ref. male)	-0.120	0.154	**-0.292** *	0.157
Marriage (ref. married)	0.178	0.186	0.172	0.190
Education (ref. middle school)				
High school	0.082	1.273	-0.102	1.290
College/university	0.004	1.267	-0.590	1.285
Graduate school	0.311	1.303	-0.519	1.322
Household income	0.000	0.000	-0.000	0.000

*: p <0.1, **: p<0.05, ***: p<0.01

[†] Discretionary activity spaces with 3Cs include eateries, nightlife facilities, cultural facilities, indoor sports facilities, outdoor sports facilities, religious facilities; while discretionary activity spaces without 3Cs include open spaces and green spaces.

2-2. Ordered logit models of discretionary activity spaces with/without 3Cs, Shanghai Metropolitan Area[†]

	Space for discretionary activity			
	Spaces without 3Cs		**Spaces with 3Cs**	
Variable	Coefficients	Std. Error	Coefficients	Std. Error
Refraining from leisure or social activities	**-0.336** ***	0.1226	-0.155	0.121
Compliance with preventive measures	-0.209	0.1352	**-0.677** ***	0.138
Risk perception of COVID-19	**0.080** *	0.0453	**0.104** **	0.045
Perceived safety in the city toward COVID-19	**0.247** **	0.112	0.061	0.111
Age	0.000	0.013	**-0.029** **	0.013
Gender (ref. male)	-0.021	0.1969	-0.159	0.196
Marriage (ref. married)	**-0.934** ***	0.2633	**-0.717** ***	0.261
Education (ref. middle school)				
High school	0.864	1.892	-1.068	1.888
College/university	-0.643	1.783	-2.192	1.784
Graduate school	-0.201	1.796	-1.965	1.797
Household income	0.008	0.008	0.008	0.008

*: p <0.1, **: p<0.05, ***: p<0.01

[†] Discretionary activity spaces with 3Cs include eateries, nightlife facilities, cultural facilities, indoor sports facilities, outdoor sports facilities, religious facilities; while discretionary activity spaces without 3Cs include open spaces and green spaces.

2-3. Ordered logit models of discretionary activity spaces with/without 3Cs, Taipei[†]

	Space for discretionary activity			
	Spaces without 3Cs		Spaces with 3Cs	
Variable	Coefficients	Std. Error	Coefficients	Std. Error
Refraining from leisure or social activities	0.291	0.158	0.166	0.155
Compliance with preventive measures	0.041	0.194	0.052	0.193
Risk perception of COVID-19	-0.061	0.061	0.061	0.060
Perceived safety in the city toward COVID-19	-0.178	0.156	0.020	0.155
Age	-0.004	0.018	0.001	0.017
Gender (ref. male)	-0.250	0.312	-0.091	0.309
Marriage (ref. married)	-0.343	0.432	**0.898** **	0.433
Education (ref. high school)				
College/university	0.155	0.945	0.615	0.928
Graduate school	0.535	0.957	1.050	0.941
Household income	-0.180	0.131	-0.168	0.129

*: p <0.1, **: p<0.05, ***: p<0.01

[†] Discretionary activity spaces with 3Cs include eateries, nightlife facilities, cultural facilities, indoor sports facilities, outdoor sports facilities, religious facilities; while discretionary activity spaces without 3Cs include open spaces and green spaces.

국문 초록

코로나 시대의 도시 장소 선택

- 동아시아 3개 도시를 사례로 –

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코로나19는 전세계인의 삶에 유례없는 영향을 미쳤다. 코로나19와 같은 전염병의 확산은 공간적인 과정으로써, 지역에 따라 상이한 발생률과 사망률을 보이는 것으로 알려져 있다. 그 가운데 도시는 전세계 인구의 절반 이상이 거주하고 있는 곳으로, 코로나19 확진자의 90% 이상이 도시 지역에 집중되어 있다. 또한, 도시 내 여러 다중 이용 시설 및 공간에서의 집단감염이 보고되면서 도시 공간을 대상으로 코로나19의 역학을 규명하기 위한 연구가 진행되었다. 도시 내에는 다양한 종류의 다중 이용 시설이 존재함에도 불구하고, 많은 연구에서는 일부의 도시 공간만을 대상으로 코로나19의 전염과 확산을 분석해 왔다. 이에 이 연구는 14종의 도시 공간을 연구에 포함하여 코로나19 팬데믹 가운데 도시민의 도시

공간 이용에 영향을 미치는 인식 및 행동 요인을 3개 도시를 대상으로 한 사례연구를 통해 밝히고자 한다.

사례연구를 진행함에 있어, 이 연구는 대한민국의 서울, 중국의 상해, 대만의 타이베이를 연구의 공간적 범위로 선정하였다. 서울, 상해, 타이베이는 코로나19 발병 초기부터 전염병의 영향을 받은 도시에 속한다. 첫 코로나19 확진 사례가 같거나 유사한 일자에 보고되었으며, 이에 따라 일제히 확산을 방지하기 위한 정책적 조치를 시행했다. 그러나 첫 확진자 보고 이후 코로나19 확산과 통제 양상에서 세 도시는 다른 모습을 보였다. 서울에서는 코로나19의 확산과 완화가 반복되며 오랜 기간 코로나19 그늘 아래에서 끊임없이 영향을 받았다. 상해의 경우, 확진 사례 보고 초기에 매우 강도 높은 이동 제한 및 도시 공간 이용 금지 조치를 시행하였고 이로 인해 지속적으로 낮은 신규 확진자 수를 유지하였다. 타이베이 및 대만의 경우, 즉각적이고 선제적인 국경 봉쇄와 과학적인 사례 추적을 통해 전염병을 영향을 매우 제한적으로 경험한 모범 방역국으로 평가받는다. 이 연구는 상기한 도시에 거주하는 만 19세 이상 성인을 대상으로 설문조사를 실시하였다. 서울, 상해, 타이베이 순서로 2020년 9월 23일-10월 7일, 2020년 9월 8일-2021년 1월 8일, 2020년 10월 15일-2021년 1월 4일에 설문조사를 시행하였다. 표본 크기는 각각 537명, 398명, 152명이다.

선행연구 검토를 통해 도시 공간 이용에 영향을 미치는 변수로, 코로나19에 대한 위험인식, 코로나19에 대한 도시 안전도 인식, 방역 및 전

염병 통제 정책을 도출하였다. 또한 크론바흐 알파값을 계산해 모형에 포함될 복수의 설문문항을 하나의 요인으로 묶고 이를 통계모형에 투입하였다. 개인의 인식 및 행동 변수가 도시 공간 방문에 미치는 영향을 조명하는 데 있어, 문헌검토를 통해 14종의 도시 공간을 3가지 활동 공간 (필수 활동 공간, 유지 활동 공간, 여가 활동 공간)으로 분류하여 분석 결과를 제시 및 해석하였다.

분석모형으로는 순서형 로짓 모형을 채택하였다. 반응변수가 11점 리커트식 척도로 구성되어 “코로나19 발병 이전과 비교한 현재의 도시 공간 방문 수준”을 질문한 문항이기 때문이다. 반응변수가 순서형 범주를 가진다는 점을 고려하여 순서형 로짓 모형을 수행하였다.

분석 결과, 우리나라 수도권에서 모든 유형의 공간 방문에 공통적으로 영향을 미치는 인식 및 행동 요인으로 여가 및 사회활동 자제와 코로나19에 대한 위험인식이 도출되었다. 개인적인 여가 및 사회활동을 자제할수록, 코로나19에 대한 위험인식이 높을수록 모든 종류의 도시 공간 방문을 덜 방문하는 것으로 나타났다. 필수 활동 공간을 제외한 유지 활동 공간과 여가 활동 공간 방문 증가에 영향을 미치는 요인으로는 도시에 대한 높은 안전도가 도출되었다. 개인이 거주하고 있는 도시가 코로나19로부터 안전하다고 인식할수록 해당 공간을 더욱 자주 방문한다고 해석할 수 있다.

상해 대도시권에서는 방역 정책에 대한 순응이 모든 유형의 도시 공간 방문을 감소시키는 것으로 나타났다. 이는 중국 국민의 정부에 대한 높

은 신뢰도와 충성심 등 중국 특유의 사회 정치적 배경에 따른 결과로 추측된다. 여가 및 사회활동 자제는 업무 시설 및 학교를 뜻하는 필수 활동 공간 방문 감소에만 영향을 미치는 것으로 분석되었다. 또한, 서울과 다르게 코로나19에 대한 위험 인식이 높을수록 유지 활동 공간과 여가 활동 공간에의 방문이 증가하는 것으로 나타났다. 설문조사 당시 오랜 기간 낮은 일일 신규 확진자 수가 유지되며 전염병이 효과적으로 통제되고 있었기 때문에, 코로나19에 대한 위험인식이 높음에도 불구하고 해당 공간에의 방문이 줄지 않고 늘어난 것으로 생각된다.

타이베이에서는 모든 유형의 도시 공간 방문에 공통적으로 영향을 미치는 인식 및 행동 요인이 도출되지 않았다. 다시 말해, 코로나19 발병 이전과 비교한 당시의 공간 방문 수준 변화에 영향을 미치는 요인이 존재하지 않는다는 것이다. 타이베이는 전염병의 영향을 매우 제한적으로 경험한 도시이기 때문에, 코로나19 발병 이전과 이후의 도시 공간 이용에 관여하는 변수가 존재하지 않았던 것으로 추측된다. 마지막으로 필수 활동 공간과 여가 활동 공간 방문 증가에 영향을 미치는 요인으로 여가 및 사회활동의 자제가 나타나 나머지 두 도시와는 상반된 결과를 보였다.

위의 과정을 통해 세 도시의 공간 방문에 영향을 미치는 인식 및 행동 요인과 변수를 확인하였다. 이 연구는 코로나19 확산의 중심지인 도시 공간을 조명하고, 도시 공간 이용에 관여하는 도시민의 인식 및 행동 변수를 확인하였다는 점에서 의의를 가진다. 이 연구를 통해 선행 연구에

서 제시된 공간 이용 관련 변수를 일부 재확인하였으며, 도시별 코로나19 확산 양상, 감염병 대응 정책, 각 국의 사회 정치적 특성 등을 배경으로 각 도시의 결과를 해석하였다. 이를 바탕으로 감염병 대응 및 통제 정책 설계 시에 시민들의 인식 및 행동 요인을 고려할 필요성과 위험 커뮤니케이션의 중요성에 대한 정책적 함의를 제시하였다.

주요어: 코로나바이러스감염증-19, 코로나19, 감염병, 도시 공간, 도시 공간 방문, 순서형 로짓 모형

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