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The Impact of Urban Form on the Spread of Infectious Diseases:

Focusing on COVID-19 Outbreak in the Seoul Metropolitan Area*

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Abstract: COVID-19 is raising awareness about the risk of the global spread of infectious diseases. As a result, various measures have been proposed to reduce the spread of infectious diseases. This study attempts to analyze the impact of the urban form on the spread of infectious diseases and suggests an urban planning approach to prevent their spread. Recently, studies have shown that confirmed cases increase in high-density, compact cities, but this seems to be the result of simply looking at urban forms in terms of density. Therefore, this study attempted to examine urban forms by considering not only density but also accessibility, self-sufficiency, and land-use mixes. In this study, a structural equation model is used to illustrate the spread of infectious diseases in relation to urban forms, with variables representing the number of confirmed cases. This research focuses on Seoul and Gyeonggi-do, two densely populated, urbanized areas in South Korea, to study the relationship between urban spatial structures and the number of confirmed COVID-19 cases. The study found that urban forms prone to sprawl are vulnerable to the spread of infectious diseases. Moreover, the higher a region's self-sufficiency and the denser and more compact the cities, the more resistant they are to infectious diseases. This means that it is necessary for future urban planning to consider aiming for dense, compact designs in order to create cities resistant to infectious diseases, such as COVID-19. Moreover, it has been determined that cities will be able to prevent the spread of infectious diseases if urban plans, such as community plans, are promoted to enhance self-sufficiency.

Key Words: Urban Planning, Urban Form, Infectious Diseases, COVID-19

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I. Research Background

Since the WHO declared a pandemic caused by COVID-19 on March 11, 2020, the world has faced great changes. From the first outbreak of COVID-19 in Wuhan, Hubei Province, China on December 31, 2019 to August 20, 2020, approximately 22 million confirmed cases and 780,000 deaths occurred worldwide, while 16,346 cases occurred in Korea. As urban planning is deeply related to large-scale infectious diseases, discussions on urban forms and infectious diseases have begun.

When we look into the structure of the COVID-19 spread, we find that confirmed cases are occurring mainly at the nodes where means of transportation, such as public transportation and vehicles, are concentrated in cities. It has been pointed out that infectious diseases are spreading around large cities and major transport axes by those looking at overseas cases in Europe and the United States. Accordingly, concerns have been raised that the high-density and compact urban form, which has been emphasized for sustainability in urban planning, may paradoxically be vulnerable to infectious diseases. In particular, as the importance of social distancing began to be emphasized, discussions on the relationship between urban form and infectious diseases expanded to discussions on appropriate density (Yoon et al., 2020). For example, according to the New York Times, one in every 1,000 people in New York City has been infected with COVID-19, which is five times as much as the US average (Oh et al., 2020). In other words, high-density and compact cities such as New York may be more susceptible to infectious diseases than outwardly sprawling cities such as Los Angeles, which raises the need for a low-density and outwardly sprawling city in the era of new infectious diseases.

However, this may be the result of simply viewing urban forms in terms of density. As the influence of urban form on disaster damage and air quality has been confirmed, theoretical discussions have continued on high density and compact cities in the field of urban planning. The main point of the theoretical discussion on high-density/compact cities and low-density/sprawling cities is whether to classify urban forms in terms of density (Gordon and Richardson, 1997) or fragmented development patterns in consideration of accessibility (Ewing, 1997). In order to discuss urban form, not only density, but also accessibility, self-sufficiency, and land-use mixing within the region should be considered (Hamidi et al., 2015).

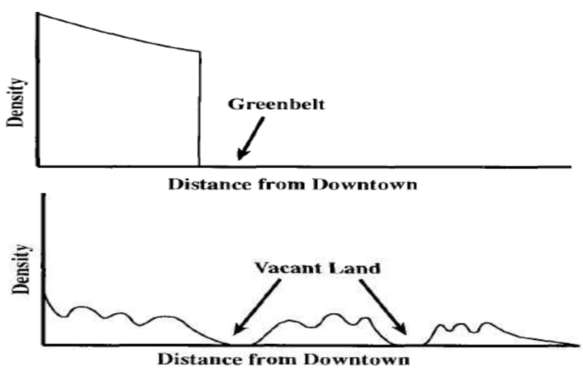
This study aims to demonstrate the impact of urban form on the spread of infectious diseases by focusing on the Seoul Metropolitan Area and analyzing the relationship between its urban form and confirmed COVID-19 cases. As the severity of COVID-19 increases, and urban forms such as regional fragmented settlement patterns and unregulated urbanization affect the health of residents, the need is raised for comprehensively reconsidering the health sector in urban planning to prevent infectious diseases (WHO, 2020). Research on the impact of urban forms on COVID-19 is ongoing. According to previous studies, urban form did not have a statistically significant impact on the number of confirmed cases of infectious diseases (Hamidi et al., 2020b). However, this previous study only defined urban form in terms of density. This study differs from previous studies in that it demonstrates the influence of urban forms on infectious diseases by considering not only density, but also regional fragmented development patterns.

Ⅱ. Theoretical Considerations

1. Theoretical Consideration on Urban Form

In the field of urban planning, theoretical discussions on high-density/compact cities and low-density/sprawling cities are ongoing. The debate on compact cities and sprawling cities began with criticism of Ewing's (1994) research on sprawl in Gordon and Richardson's (1997) paper, "Are Compact Cities a Desirable Planning Goal?". Gordon and Richardson countered Ewing's argument that sprawling, determined by consumer preference, causes farmland development, energy consumption, and transportation problems, and has both disadvantages and advantages. In response, Ewing (1997) pointed out that Gordon and Richardson's (1997) concept of compact/sprawl is different from his own in a counterpart paper, "Is Los Angeles-Style Sprawl Desirable?". Compact form suggested by Gordon and Richardson's view has very high central and average densities, on the contrary Ewing's compact form is multicentered, has moderate densities 〈Figure 1〉.

〈Figure 1〉 Different perspective of urban form
(Ewing, 1997; Above: G&R, Below: Ewing)



Gordon and Richardson classified urban forms only based on density, whereas Ewing classified urban forms in terms of not only density, but also accessibility and self-sufficiency. Specifically, Gordon and Richardson classified urban form based on population and the density of infrastructure, such as roads, and facilities, while Ewing considered both density and self-sufficiency (as represented in the urban accessibility index) in terms of land cover and traffic. After the debate between Ewing and Gordon and Richardson, urban planner began to consider urban form as connectivity and self-sufficiency whether daily life of residents is possible within region, rather than simply defining urban form as density.

2. Urban Form and Infectious Diseases

The health of local residents is an important input and outcome of urban and regional planning (WHO, 2020). In other words, according to urban and regional plans, urban forms will affect the difference in the spread of infectious diseases. As urban forms with high density and high connectivity become important for health (WHO, 2020), related research has been underway.

According to previous studies, the more dense and compact cities are, the more likely they are to be exposed to infectious diseases because close contact occurs frequently between local residents (Glaeser, 2011). In other words, since high-density and compact cities have an effect on the increase in the number of confirmed COVID-19 cases, it is necessary to consider a new urban form rather than a high-density and compact city to respond to new infectious diseases. This is theoretically because the higher the city density, the higher the likelihood of hot spots that can encourage the spread of infectious diseases by inducing close contact and interaction between residents (Hamidi et al., 2020a). When the influenza outbreak in the United States in 1918 was analyzed, the relationship between the mortality rate from infectious diseases and urban density showed a positive correlation (Garrett, 2008).

On the other hand, there are previous studies that show that the more dense and compact cities are equipped with health facilities for local residents, and the more land use efficiently reduces the movement of local residents, the lower the actual infection rate will be (Hamidi et al., 2020a; Dye, 2008). Moreover, when certain variables influencing the infection rate were controlled, city density was not statistically significant with the rate of confirmed cases of infectious disease (Hamidi et al., 2020b), and city density did not have a statistically significant effect on the spread of infectious diseases (Chowell et al., 2008). Research results that a dense and compact urban form like New York seems to serve as a hub for the spread of infectious diseases, but after the early stages of COVID-19 outbreak urban form did not affect the spread of infectious diseases support that dense and compact form does not increase confirmed cases (Carey and Glanz, 2020).

The reason why previous studies on the relationship between high-density/compact cities and infectious diseases show conflicting empirical results is that previous studies considered urban form only in terms of density. In fact, an analysis of the US showed that connectivity, rather than urban density, had an effect on the spread of COVID-19 (Hamidi et al., 2020a). In other words, in order to analyze the impact of urban form on the spread of COVID-19, it is necessary to consider urban form not only in terms of urban density, but also connectivity and self-sufficiency. Connectivity and self-sufficiency refers to the degree to which residents perform activities of daily living such as commuting to school, work, shopping and entertainment.

In addition, the floating population, affected by spatial structures and forms such as urban connectivity and self-sufficiency (Sung and Kwak, 2016), was found to be a vulnerable factor in the spread of infectious diseases (Son, 2020; Lee, 2015). In other words, the spatial structure and form of a city inevitably affects the scope of activities of its local residents. In cities with low self-sufficiency, generate traffic for commuting, schooling, and shopping to other areas of local residents. So, cities with low self-sufficiency, the floating population rises, increasing contact with local residents and thereby increasing the possible spread of infectious diseases. In particular, in the case of infectious diseases with strong contagious power (such as COVID-19), social distancing measures alone cannot prevent the spread of infectious diseases, so it is necessary to consider the floating population that is affected by the urban form.

3. Research Questions and Hypotheses

This study begins by asking, "Although high-density and compact cities are a sustainable urban form for solving various urban problems, can they be effective in situations where infectious diseases such as COVID-19 are spreading? Even if the density is high, can the spread of infectious diseases be prevented if the connection is high and self-sufficiency within the region is high?" The following research questions and hypotheses were set up to analyze the impact relationship in terms of accessibility as well as density.

Research Question 1: Will urban form affect the spread of infectious diseases such as COVID-19?

Research Question 2: Is the form of a dense, compact city with high accessibility and self-sufficiency vulnerable to the spread of infectious diseases?

Research hypotheses for research questions 1 and 2 were formulated based on theoretical considerations on urban form and infectious diseases.

Research Hypothesis 1: Depending on the urban form(in terms of density, connectivity and self-sufficiency), there will be a difference in the number of confirmed infectious diseases.

Research Hypothesis 2: Even if they are dense and compact cities, the more floating populations will not have a significant effect on the spread of infectious diseases.

Ⅲ. Data and Methodology

The case area for this study is the Seoul Metropolitan Area, including Seoul City and Gyeonggi Province. In South Korea, the Seoul Metropolitan Area contains more than 50% of the population and plays a key role in the economy, society, and culture. The spread of infectious diseases in the Seoul Metropolitan Area can lead to serious consequences, such as quarantine problems caused by increases in the number of confirmed cases, national economic recession, and halted political and social decisions. Moreover, cities in Gyeonggi Province, including Seoul, have distinct urban spatial structures for each region. Therefore, the Seoul Metropolitan Area is suitable for discussing the research hypotheses presented in this study.

This study used the Structure Equation Model (SEM) as an analytic tool. The SEM is a model that verifies the causal relationship between mutual variables and their significance by using the analysis method of the structural model theory to identify specific phenomena (Heo, 2013). In this study, we tried to expand the discussion of urban form and sprawl from the perspective of containing infectious diseases and to understand the complex causal relationship between confirmed cases and urban form features such as density, connectivity, and aggregation by using SEM as a research methodology. The variables used in this study consist of one outcome variable, which is the number of confirmed COVID-19 cases, and three explanatory variables, consisting of population, connectivity, and aggregation type. The number of confirmed COVID-19 cases used in this study was the official COVID-19 data provided on the homepage of the si-gun-gu (city) corresponding to the case area. The temporal scope is from January 24th, 2020, when the first confirmed COVID-19 case occurred in the Seoul Metropolitan Area, to 00:00 on August 14th, 2020. In the case of the population type variable, variables representing the floating population and the fixed population were collected, and the floating population data was collected using this floating population map service with the mobile big data provided by the National Statistical Office. Also, floating population data from August 2019 to May 2020 were provided by SK Telecom corporation. Other population data were collected based on the census data provided by the National Statistical Office.

For the connectivity and aggregation variables, the fragmentation index, which measures urban form on the side of land cover, was used. The fragmentation index was calculated using the FRAGSTATS program after processing the land cover map provided by the Environmental Geographic Information Service. FRAGSTATS is a open source program developed by Dr. Kevin McGarigal to compute a wide variety of landscape metrics (https://www.umass.edu/landeco/research/fragstats/ fragstats.html). The land cover map of the Environmental Geographic Information Service includes a total of seven types of land cover, including urbanization areas, agricultural areas, forest areas, grassland, wetlands (waterside vegetation), bare land, and water bodies, and each type of land cover is classified through a unique code. Among them, urbanization area land cover was extracted and used in the late 2010s within the range of si-gun-gu. In FRAGSTATS, various indices with characteristics such as area, aggregation, continuity, and proximity can be calculated; we used indices with characteristics of connectivity and aggregation. Connectivity and aggregation variables were calculated using FRAGSTATS, after processing the urbanization areas land cover data of the si-gun-gu unit by 30 m×30 m grid cells with ArcGIS program.

In this study, prior to conducting the SEM, the linearity of the causal relationship between the variables was ensured by testing the normality of the variables derived through analysis of previous studies. The reliability of the SEM in this study was improved by analyzing the correlation between the number of confirmed cases and other variables, which are the observed variables that play the role of endogenous variables in the structural equation. Control variables such as gender ratio, number of urban planning facilities, number of beds, obese population ratio, infrastructure density, residential/ commercial/ industrial area, etc., derived from the analysis of previous researches were included, but due to the significance of the correlation coefficient variables, they were not included in the SEM. Previous studies showed that contorl variables had an effect on the spread of infectious diseases, but in this study, control variables did not have a statistically significant effect as a result of correlation analysis with the nubmer of confirmed COVID-19 cases. This seems to be because control variables were not related to the spread of COVID-19 or did not have a significant effect in the Seoul Metropolitan Area, which is the site area of this study. Finally, variables that showed statistically significant with COVID-19 confirmed cases according to correlation analysis in this study are shown in 〈Table 1〉.

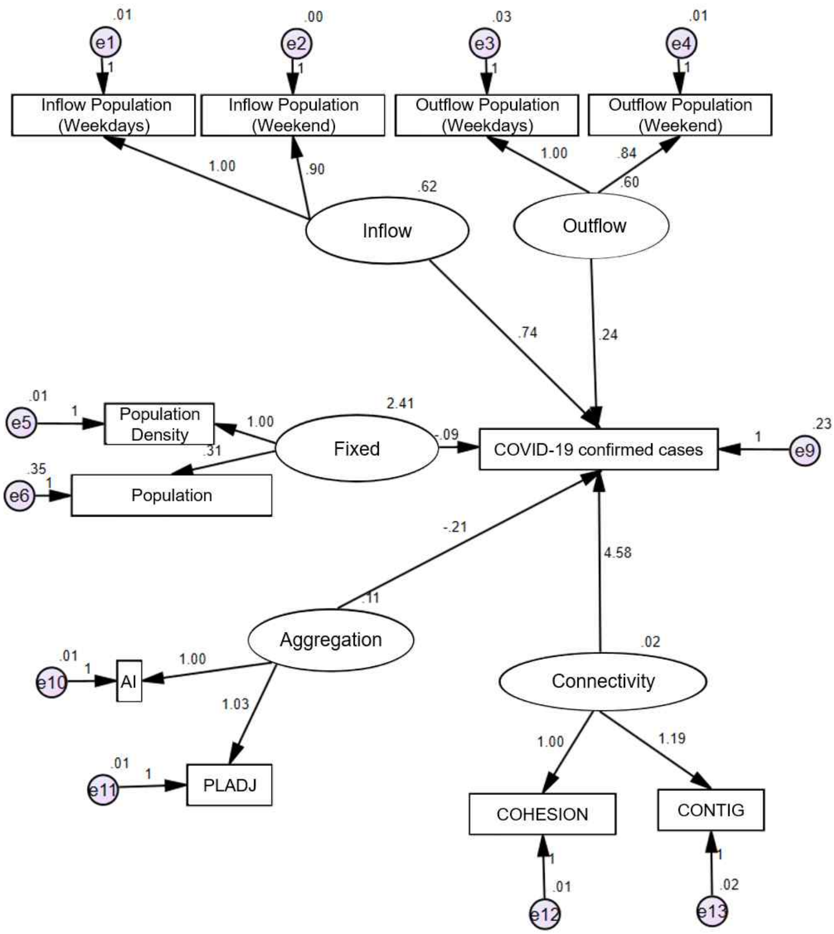
〈Table 1〉 Variables

Variable Name	Description	Pearson Correlation
Outcome variables		
Confirmed Cases	COVID-19 confirmed cases in the case area from 2020.01.24. to 2020.08.14.	-
Explanatory variables		
Inflow Population (Weekdays)	(Self sufficiency)Weekday inflow population provied by SKT from 2019.08~2020.05.	.845**
Inflow Population (Weekend)	(Self sufficiency)Weekend inflow population provied by SKT from 2019.08~2020.05.	.824**
Outflow Population (Weekdays)	(Self sufficiency)Weekday outflow population provied by SKT from 2019.08~2020.05.	.857**
Outflow Population (Weekend)	(Self sufficiency)Weekend outflow population provied by SKT from 2019.08~2020.05.	.804**
Population Density	Si-gun-gu Population/Si-gun-gu Area	.668**
Population	Number of people living in urban areas	.862**
PLADJ	Degree of patch aggregation	.691**
AI	Extent to which patches are adjacent to each other	.747**
COHESION	Physical connectivity of the patch	.688**
CONTIG	Spatial connectivity of cells within a grid cell patch	.445**

* Significant at the 0.05 level, ** Significant at the 0.01 level

※ The patch is the smallest land cover unit in landscape ecology, and in this study, it can be called an urbanized area

〈Figure 2〉 Path diagram framework



AMOS was used for SEM analysis, and a latent variable representing the characteristics of each explanatory variable was set. The causal relationship between the number of latent variables and the outcome variable was to be identified. The SEM of this study was composed of a total of five latent variables based on the variables that were significantly derived from the correlation analysis, with the number of confirmed cases as the outcome variable 〈Figure 2〉. First, the floating population was divided into inflow and outflow potential variables, and each floating population potential variable consisted of inflow and outflow populations on weekdays and weekends. For comparison with the floating population, a fixed population latent variable was set, and the fixed population latent variable was composed of the observed variables of population density and the number of people in urban areas. Finally, the latent variables of aggregation and connectivity were constructed in relation to urban form. Aggregation consisted of variables representing the degree of aggregation of the patches. Fragmentation indices constituting the aggregation variable were used to measure sprawl in previous studies. The higher the values of these indices, the higher the density and compactness of the area, and the less fragmented it was (Ji et al., 2006; Lim and Kim, 2016). Connectivity is a fragmentation index that represents the physical and spatial connectivity of a patch, and the higher the values of the indices, the higher the physical and spatial connectivity of the urbanized area in the region (Brody et al., 2017).

Ⅳ. Analysis Results

〈Table 2〉 is the result of analyzing causality between variables through SEM. “Inflow,” “Outflow,” and “Fixed” variables are latent variables representing the demographic characteristics of the region; they allow interpretation of the causality of the number of confirmed cases of COVID-19 and population characteristics. First, by fixing a parameter to one of the path coefficients of each latent factor, the relative contribution of each measurement variable was identified, and errors that can occur during model analysis were eliminated. The ESTIMATE value shown in 〈Table 2〉 indicates causality, and 1 is a value for setting a reference point in the path of the observed variable that constitutes the latent variable for fixing each parameter.

〈Table 2〉 Analysis results

Evaluation Path			Results				
Outcome Variable		Latent Variable	Estimate	S.E.	C.R.	P	Label
Inflow Population (Weekdays)	<--	Inflow	1				
Inflow Population (Weekend)	<--	Inflow	0.904	0.017	54.472	**	par_1
Population Density	<--	Fixed	1				
Population	<--	Fixed	0.31	0.063	4.915	**	par_2
Confirmed Cases	<--	Inflow	0.742	0.114	6.489	**	par_3
Confirmed Cases	<--	Fixed	-0.088	0.058	-1.532	0.125	par_4
AI	<--	Aggregation	1				
PLADJ	<--	Aggregation	1.029	0.052	19.776	**	par_5
COHESION	<--	Connectivity	1				
CONTIG	<--	Connectivity	1.19	0.213	5.591	**	par_6
Confirmed Cases	<--	Aggregation	-0.208	0.279	-0.745	0.456	par_7
Confirmed Cases	<--	Connectivity	4.58	0.793	5.774	**	par_8
Outflow Population (Weekdays)	<--	Outflow	1				
Outflow Population (Weekend)	<--	Outflow	0.839	0.033	25.611	**	par_9
Confirmed Cases	<--	Outflow	0.241	0.116	2.082	0.037	par_10

* Significant at the 0.05 level, ** Significant at the 0.01 level

Among latent variables, the “Inflow” variable showed significant causality with the inflow population (weekdays), inflow population (weekend), and confirmed cases. In the case of the relationship with confirmed cases, which is a key variable for hypothesis testing, it was found that the number of confirmed cases showed a positive causal relationship with the inflow. The “Outflow” variable was also found to have a significant positive causal relationship with the confirmed cases. This can be interpreted as increasing the number of confirmed cases due to the large number of outflows returning home after visiting other regions. On the other hand, it was found that the “Fixed” variable did not show a significant causal relationship with the number of confirmed cases. This can be interpreted as meaning that the population density in a specific area does not, by itself, significantly affect increases or decreases of confirmed cases. In addition, when comparing the effects of floating population variables (self sufficiency) on the COVID-19 confirmed cases, it was found that the influence of the “Inflow” variable was greater than that of the “Outflow” variable. This can be interpreted in connection with the characteristics of urban form and floating population in the Seoul Metropolitan Area. In case of Seoul Metropolitan Area, due to high land prices, residential functions are concentrated in outskirts, while major commercial and business functions are concentrated in center. Due to urban form of the Seoul Metropolitan Area, it is interpreted that COVID-19 confirmed cases in the metropolitan area are more affected by the population flowing into center rather than the population leaking into the outskirts.

The variables “Aggregation” and “Connectivity” are latent variables that represent urban form and indicate the causality of urban form characteristics with respect to the number of confirmed cases. First of all, the “Aggregation” variable, which symbolizes high density, did not show a significant relationship with the number of confirmed cases. However, the “Connectivity” variable showed a significant positive causal relationship with confirmed cases. To interpret this comprehensively, it cannot be said that the number of confirmed cases of infectious diseases increases just because the city has a dense form. However, it can be interpreted that the number of confirmed cases increases as the connectivity of the localized areas increases.

In this study, two research hypotheses were established: the difference in the number of confirmed cases of infectious diseases would vary depending on the urban form, and the regions with higher connectivity and self-sufficiency would not have a significant effect on the spread of infectious diseases despite dense and compact cities. The first research hypothesis was adopted because it was found that the “Connectivity” variable, which is a latent variable representing the urban form, has an effect on the number of confirmed cases. However, the second research hypothesis was inevitably rejected because the “Aggregation” variable representing high density and compactness showed insignificant causality with the number of confirmed cases; instead, the “Connectivity” variable showed positive causality. However, the “Connectivity” variable used in this study is a value that refers to the physical connectivity of a patch unit, and it shows high connectivity even when the city is fragmented and has only physical connectivity. Therefore, when considering the characteristics of the Seoul Metropolitan Area, where sprawl is severe, high infection rate can be interpreted as a result of the urban form, which has high connectivity but is not dense. In other words, if the external development of the city is strengthened and the connectivity is strengthened through physical infrastructure (such as roads) in a state that is not dense or compact, the number of confirmed cases of infectious diseases such as COVID-19 is likely to increase. Moreover, if the result of analyzing the "Connectivity" variable is interpreted together with the result of the floating population analysis, it can be interpreted that the number of confirmed cases increases as the external connections between si-gun-gu and internal connections within the region increase. This is a result of increased external connectivity in cities with low self-sufficiency rather than connectivity, which represents the spatial structure and urban form.

V. Conclusions and Policy Implications

1. Conclusions

This study has examined whether urban forms affect the spread of infectious diseases such as COVID-19. It asked, is the form of dense and compact cities with high accessibility and self-sufficiency vulnerable to the spread of infectious diseases in Seoul Metropolitan Area?

The Seoul Metropolitan Area-centered urban form in this study cannot be used to assess all outbreaks of infectious diseases. Furthermore, since it only targets confirmed cases of COVID-19 that occurred in Korea over 6 months, there is inevitable bias in the sample selection process. Moreover, although the number of confirmed COVID-19 cases across the country, including the Seoul Metropolitan Area, is increasing rapidly as of August 15, there is a limitation in that this was not reflected in the analysis process. However, since the temporal and spatial ranges set in this study do not include irregular situation such as pendamic of Daegue city in February pendamic after August Seoul demonstration, the analysis reuslts can be generailzed in South Korea. In addition despite the limitations, this study is meaningful in that the relationship between COVID-19 confirmed cases and urban forms in terms of density and connectivity was exploratoryly confimred. The main results are as follows.

○ Urban forms with strong physical connectivity that are not compact were vulnerable to the spread of infectious diseases in Seoul Metropolitan Area.
○ The higher the self-sufficiency in the region and the more dense and compact the cities, the more resistant they are to infectious diseases in Seoul Metropolitan Area.

From the above two results, we conclude that the high-density and compact city form is not vulnerable to COVID-19 in Seoul Metropolitan Area. Therefore, in order to create a city that is resilient to infectious diseases such as COVID-19, it is necessary to develop a high-density and compact form of the city while, at the same time, promoting self-sufficiency in the region.

However, it is believed that urban form has a certain relationship with the spread of infectious diseases. In the future, various diseases other than COVID-19 will be added to expand research on infectious diseases. Furthermore, research at the national level is necessary beyond the regional level. Regardless, it is concluded that there is a need to establish a sustainable urban model that responds to infectious diseases.

2. Policy Implications

The results of this study confirm that the number of confirmed cases of infectious diseases such as COVID-19 varies depending on urban form. Therefore, in the post-COVID-19 era, urban planning is necessary that takes into account infectious diseases. However, this does not imply that it should deviate greatly from the existing urban planning paradigm. According to the analysis results, greater connectivity produces a higher number of confirmed cases. However, in terms of density, there was no significant result; this is likely because only physical connection was strengthened as the Seoul Metropolitan Area sprawled. In other words, if the city is fragmented and only increases connectivity, we are likely to see increases in the number of confirmed cases as unnecessary traffic lines increase. Therefore, it is necessary to reduce unnecessary traffic lines by rethinking the urban form as high-density and compact. At the same time, it is necessary to avoid fragmented development and pursue centralized and mixed land use.

Beyond this, there is a need to reduce the floating population of any at-risk city. This is because the floating population was found to be a major factor affecting the number of confirmed cases in this study. The most important way to do this is to increase self-sufficiency in the region. Self-sufficiency will be a key word in the post-COVID-19 era since self-sufficiency refers to the degree to which residents perform activities of daily living such as commuting to school, work, shopping and entertainment. Currently, disease control authorities are trying to suppress movement between regions as much as possible, except for inevitable movement. However, in addition to policy measures to restrain unnecessary movement, measures to reduce necessary population movement must also be devised. This includes commuting to work and the movement of logistics, which cannot be suppressed even in the current COVID-19 situation. In order to reduce these essential movements, the key method is to establish a workplace and a part of the logistics system within the affected region. This is in line with policies that increase local self-sufficiency. It is also consistent with the existing urban planning paradigm.

In fact, various urban plans have already been established and promoted together to improve the self-sufficiency of the region. Currently, Seoul City is establishing the 2040 Seoul Plan. The Seoul Plan is a plan that incorporates macroscopic changes in urban space and proposes urban policies that will lead to urban space change after the COVID-19 outbreak. In connection with the completed 2040 Seoul Plan, it is possible to discuss more broadly the arrangement of the overall urban space in Seoul, taking into account self-sufficiency. Urban planning with high self-sufficiency is needed to provide a perspective on the connectivity between regions and to propose a macroscopic urban structure in the post-COVID-19 era. In particular, the community plan implemented in Seoul was also one of the measures to increase self-sufficiency in this area. The community plan is the first system implemented in Korea and is a top-down intermediate plan established by local residents. It is believed that a more effective post-COVID-19 era urban form can be established by implementing policies that promote self-sufficiency and accessibility centered on the community plan. Moreover, in order to prepare for infectious diseases, it is expected that a new foundation for disease control can be laid by proposing policies that include facilities such as health and medical care as essential elements in the community plan. In the post-COVID-19 era, urban planning that can promote such self-sufficiency should be expanded.

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