A STUDY TO ESTIMATE THE IMPACT OF GREEN INFRASTRUCTURE TO HUMAN HEALTH BY COMBINING NDVI AND ASTHMA DATA

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ABSTRACT: Human health is a very fundamental and key factor in human life, and the importance and interest in health and public hygiene have increased significantly experiencing the recent COVID-19 pandemic. As the importance of health and welfare gradually emerged, the impact of natural environment on human became important as well. The importance of natural environment has also become a critical factor in urban planning, so that various research on the impact of green infrastructure in urban areas on human health is also being conducted. In particular, studies have shown that neighborhood greenness may impact human health and lower the risk of various diseases. Demoury et al. (2017) also published research results that green environments can possibly lower the risk of obesity and cardiovascular disease. As well as these physical health, there is a study to find out the relation between green space and human mental health.

However, among various diseases, as the importance of respiratory diseases has recently been highlighted due to COVID-19, we tried to examine the relationship between respiratory diseases and urban green areas. Therefore, this study attempted to analyze the relationship between urban green infrastructure and human health using NDVI and asthma data as a follow-up study conducted in 2018 to figure out the relation between greenness and cancer.

As a result, asthma has no relationship with NDVI. This result is similar to that of study conducted in 2018, which was to find out the relationship between greenness and cancer. However, we found that the relation between cancer and demographic variables are much stronger than that of between asthma and demographic features. This means that unlike the larger the population, the more cancer patients, there is less relationship between the population and the number of asthma patients. Therefore, we assume that there could be other factors to impact the asthma while demographic characteristic is one of the key factors.

Although this study could not directly confirm the effect of green infrastructure on asthma, it is necessary to identify various factors affecting asthma through related studies in the future.

1. INTRODUCTION

Human health is a very fundamental and key factor in human life, and the importance and interest in health and public hygiene have increased significantly experiencing the recent COVID-19 pandemic. As the importance of health and welfare gradually emerged, the impact of natural environment on human became important as well. The importance of natural environment has also become a critical factor in urban planning, so that various research on the impact of green infrastructure in urban areas on human health is also being conducted. In particular, studies have shown that neighborhood greenness may impact human health and lower the risk of various diseases (Wu et al., 2008; Brown et al., 2016). Demoury et al. (2017) also published research results that green environments can possibly lower the risk of obesity and cardiovascular disease. As well as these physical health, there is a study to find out the relation between green space and human mental health (Grahn and Stigsdotter, 2010).

However, among various diseases, as the importance of respiratory diseases has recently been highlighted due to COVID-19, we tried to examine the relationship between respiratory diseases and urban green areas. Therefore, this study attempted to analyze the relationship between urban green infrastructure and human health using NDVI and asthma data as a follow-up study conducted in 2018 to figure out the relation between greenness and cancer (Moon and Chae, 2018).

2. STUDY AREA AND DATA

Seoul city is the study area, which is the capital city of South Korea. Total 25 'gu'(administrative boroughs of Korea) was included in this study, and the whole area is around 600 km^2.

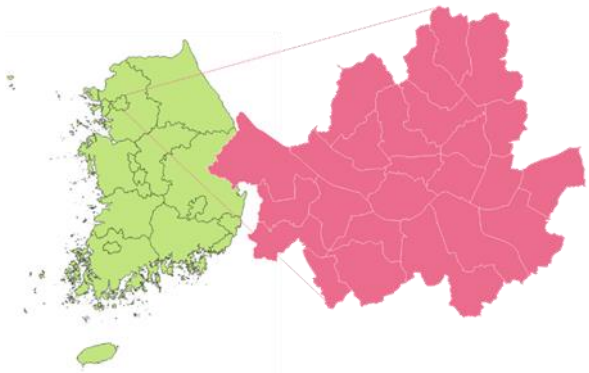

Figure 1. Study area.

Table 1. Administrative boroughs of Seoul

Jongro-gu	Mapo-gu
Jung-gu	Yangcheon-gu
Yongsan-gu	Gangseo-gu
Seongdong-gu	Guro-gu
Gwangjin-gu	Geumcheon-gu
Dongdaemun-gu	Youngdeungpo-gu
Junglang-gu	Dongjak-gu
Seongbuk-gu	Gwanak-gu
Gangbuk-gu	Seocho-gu
Dobong-gu	Gangnam-gu
Nowon-gu	Songpa-gu
Eunpyeong-gu	Gangdong-gu
Seodaemun-gu	

2.2 Data

We collected social data and satellite image for this study. Landsat 8 multi-spectral image and statistical data were used together to figure out the relation between green infrastructure and human health. Total 9 variables related to social data, which are asthma, all type of cancer, population, gender, and different age groups, were used for this study.

Table 2. Used data

Category	Name of data	Time	Data type	Resolution(m)
Statistical data	Asthma	2011	vector	N/A
	All type of cancer	2009-2013		
	Population	2010		
	Gender (Male or Female)	2010		
	Age (<15, 15-64, >64)	2010		
Satellite data	Landsat 8	16-09-2013	raster	PAN: 15 m MS: 30 m

3. METHODOLOGY

To estimate the green infrastructure, NDVI (Normalized Difference Vegetation Index) was extracted from Landsat 8 image. All types of statistical data are converted to spatial data for each 'gu' to be combined with NDVI.

Then, correlation analysis was applied to figure out whether NDVI has any relation to any type of social variables. QGIS was used to process the satellite and geospatial data, and SPSS was used to generate the statistical results.

4. RESULTS

4.1 NDVI

Following image shows the NDVI result of Landsat 8 image.

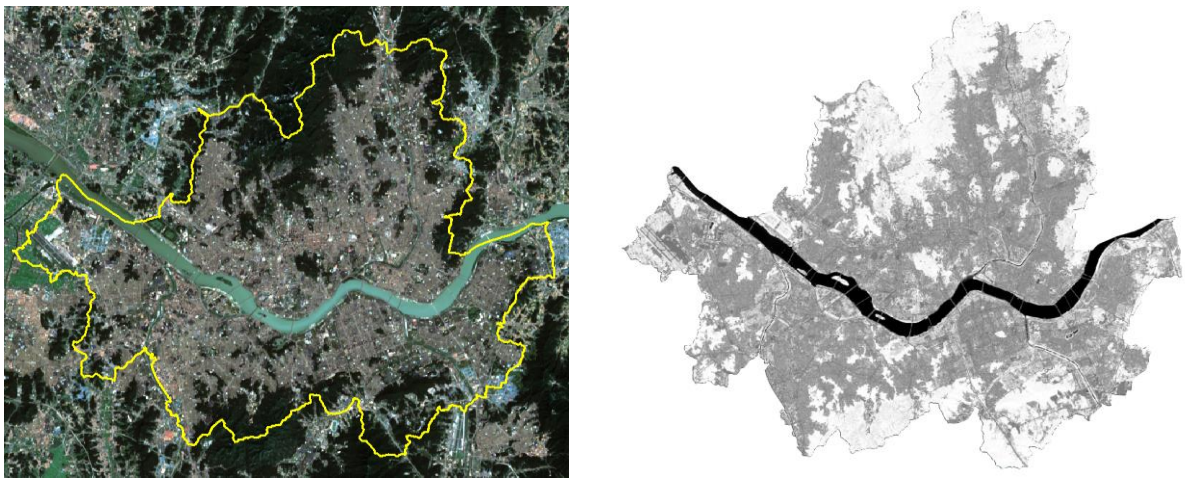

Figure 2. Original Landsat 8 image(left) and NDVI result(right).

The minimum value of NDVI was -0.585136 and the maximum value was 0.837202. If NDVI value is high, it is illustrated in bright color in the image, and means higher level of vegetative activities. While lower NDVI value is shown in dark and black color, and means lower level of vegetative activities and non-vegetation such as water or built-up area. Han river, which is located at the center of the city, is shown as black color in this image.

4.2 Statistical result

The correlation result between NDVI and social variables is summarized in the Table 3 below.

Table 3. Correlation result between NDVI and social variables

		NDVI mean	Asth-ma	Can-cer	Popula tion	No. of men	No. of women	Sex ratio	<15 age	15-64 age	>64 age
NDVI_ mean	Pearson	1	0.059	0.103	0.083	0.087	0.079	0.059	0.091	0.065	0.228
	Sig.(2-tailed)		0.781	0.625	0.694	0.681	0.780	0.780	0.666	0.756	0.272
	N	25	25	25	25	25	25	25	25	25	25
Asthma	Pearson	0.059	1	.636**	.629**	.622**	.634**	-0.221	.686**	.609**	.586**
	Sig.(2-tailed)	0.781		0.001	0.001	0.001	0.001	0.288	0.000	0.001	0.002
	N	25	25	25	25	25	25	25	25	25	25
Cancer	Pearson	0.103	.636**	1	.985**	.982**	.986**	-0.195	.958**	.981**	.903**
	Sig.(2-tailed)	0.625	0.001		0.000	0.000	0.000	0.351	0.000	0.000	0.000
	N	25	25	25	25	25	25	25	25	25	25
Population	Pearson	0.083	.629**	.985**	1	.999**	.999**	-0.155	.975**	.998**	.885**
	Sig.(2-tailed)	0.694	0.001	0.000		0.000	0.000	0.459	0.000	0.000	0.000
	N	25	25	25	25	25	25	25	25	25	25
No. of men	Pearson	0.087	.622**	.982**	.999**	1	.996**	-0.110	.972**	.997**	.886**
	Sig.(2-tailed)	0.681	0.001	0.000	0.000		0.000	0.600	0.000	0.000	0.000
	N	25	25	25	25	25	25	25	25	25	25
No. of women	Pearson	0.079	.634**	.986**	.999**	.996**	1	-0.198	.975**	.997**	.882**
	Sig.(2-tailed)	0.707	0.001	0.000	0.000	0.000		0.344	0.000	0.000	0.000
	N	25	25	25	25	25	25	25	25	25	25
Sex ratio	Pearson	0.059	-0.221	-0.195	-0.155	-0.110	-0.198	1	-0.171	-0.150	-0.145
	Sig.(2-tailed)	0.780	0.288	0.351	0.459	0.600	0.344		0.413	0.474	0.488
	N	25	25	25	25	25	25	25	25	25	25
<15 age	Pearson	0.091	.686**	.958**	.975**	.972**	.975**	-0.171	1	.964**	.853**
	Sig.(2-tailed)	0.666	0.000	0.000	0.000	0.000	0.000	0.413		0.000	0.000
	N	25	25	25	25	25	25	25	25	25	25
15-64 age	Pearson	0.065	.609**	.981**	.998*	.997*	.997**	-0.150	.964**	1	.864**
	Sig.(2-tailed)	0.756	0.001	0.000	0.000	0.000	0.000	0.474	0.000		0.000
	N	25	25	25	25	25	25	25	25	25	25
>64 age	Pearson	0.228	.586**	.903**	.885**	.886**	.882**	-0.145	.853**	.864**	1
	Sig.(2-tailed)	0.272	0.002	0.000	0.000	0.000	0.000	0.488	0.000	0.000	
	N	25	25	25	25	25	25	25	25	25	25

** Correlation is significant at the 0.01 level (2-tailed).

The above table shows that there is strong relation between asthma, cancer and population. And the relation between cancer and population is much stronger than the relation between asthma and population. Most importantly, we couldn't find any relation between NDVI and asthma. This result is also can be checked with the following figures.

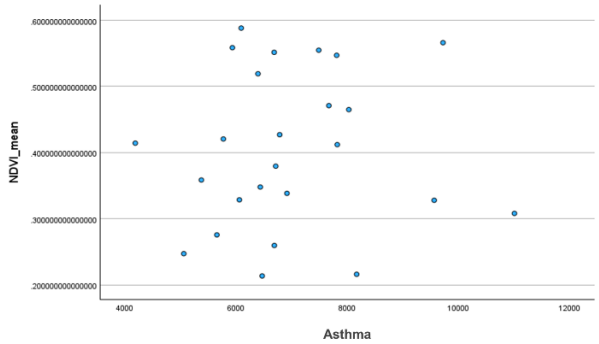

Figure 3. Scatter plot of NDVI and asthma.

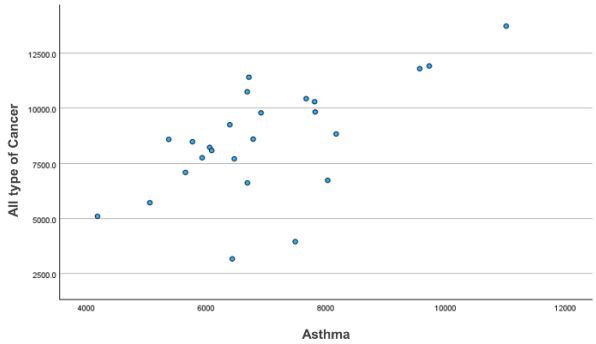

Figure 4. Scatter plot of cancer and asthma.

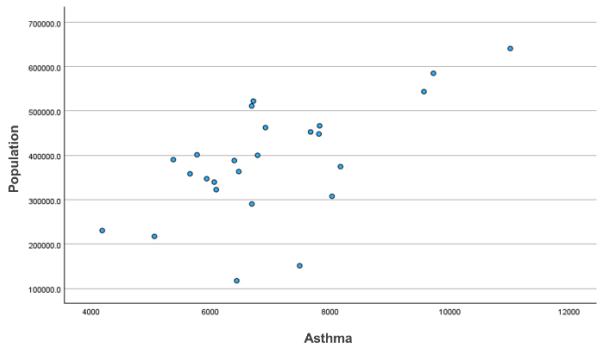

Figure 5. Scatter plot of population and asthma.

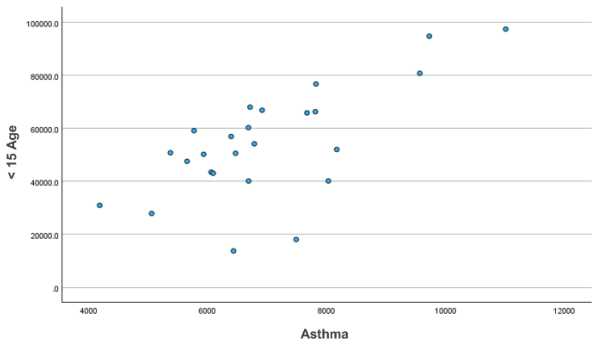

Figure 6. Scatter plot of <15 age and asthma.

As you can see above figures, there is no significant relation between NDVI and asthma. Meanwhile, a strong relation between cancer and asthma was found together with the relation between population and asthma. This study, which was conducted as a follow-up study performed in 2018, also confirmed that there was no significant relationship between asthma and NDVI. Just as the factor that affects cancer the most was the demographic factor, it was confirmed that the factor that affects asthma the most was the demographic characteristic again.

5. CONCLUSIONS

In this study, we tried to figure out the impact of green infrastructure to human health by estimating the relationship between NDVI and asthma data. NDVI was calculated using Landsat 8 image and different social variables including asthma data were used together.

As a result, asthma has no relationship with NDVI. This result is similar to that of study conducted in 2018, which was to find out the relationship between greenness and cancer. However, we found that the relation between cancer and demographic variables are much stronger than that of between asthma and demographic features. This means that unlike the larger the population, the more cancer patients, there is less relationship between the population and the number of asthma patients. Therefore, we assume that there could be other factors to impact the asthma while demographic characteristic is one of the key factors.

Although this study could not directly confirm the effect of green infrastructure on asthma, it is necessary to identify various factors affecting asthma through related studies in the future.

6. REFERENCES

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