Spatial implications of using Euclidean distance in predicting the use of oriental medicine hospital

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ABSTRACT

This study analyzed whether the patients' visits to oriental medicine hospitals were influenced by the Euclidean distance from patients' residence to oriental medicine hospitals. Patient visits to two oriental medicine hospitals in a metropolitan area were selected for study sample. The number of patient visits from each Dong (which is the smallest administrative district).to two hospitals was calculated based on inpatient claims in 2008. ArcGIS was used to calculate the distance. Distance variable was not statistically significant in regression analysis after controlling the socio-economic status of each Dong. It seems that distance factor does not play an important role in deciding whether to use the services of oriental medicine hospitals.

Keywords : Oriental medicine hospital, Euclidean distance, Patient visit, ArcGIS

1. Introduction

The suitability of hospital location is one of the key factors for hospital survival in current healthcare market. When new hospitals were built, generally hospital sites were decided where the accessibility between people and hospital is good (Boscarino & Flexner, 1981). Especially, the location is much emphasized in the mid-size hospital groups because of the attributes of patients. It is said that large portion of their patients come from their neighborhood which is not far from their hospital (Kim, 2006). A study proposed that distance is one of the factors which influence the health care demand (Lee, 1997). The effects of distance on patient visits were not studied in oriental medicine areas.

This study purposed to analyze whether the distance had influenced the patients' visits to oriental medicine hospitals after controlling the differences of geographical attributes.

2. Methods

2.1 Sample data

This study included two oriental medicine hospitals which operated in Daejeon metropolitan city. They were owned by same school of oriental medicine. Two hospitals showed similar number of beds. Daejeon is one of the largest cities in Korea and the number of population is about 150million. It is composed of five ward offices and 81 Dongs (which is the smallest administrative district).

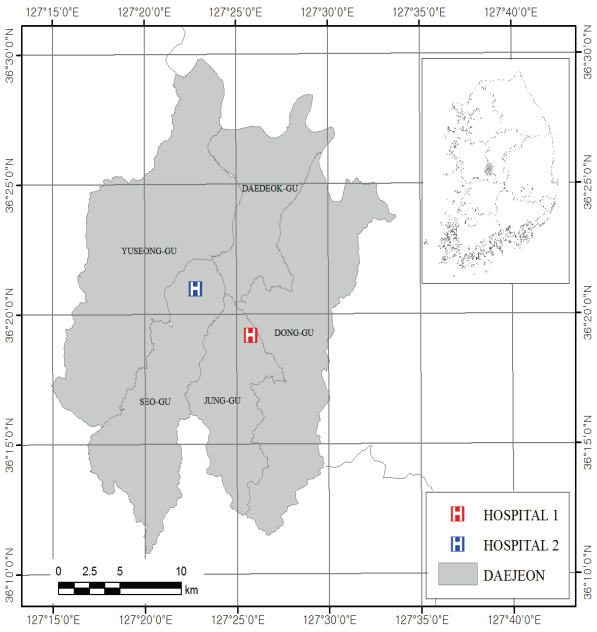

Figure 1. Oriental medicine hospitals in study areas

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The number of inpatient and outpatients of study hospitals was used in analysis as the performance data. The number of patient visits from each Dong to two hospitals was calculated based on inpatient claims in 2008. Inpatient claims were used to identify their address.

2.2 Measuring distance

Distance from patients' residence to hospital location was measured by the spider diagram in ArcGIS 9.3(Figure 2). It determines distances between hospitals to all centroid points at Dongs. Jones et al (2010) argued that drive distance from the geocoded address was highly correlated with the Euclidean distance from the zip-code centroid. They proposed that Euclidean distance measurements and geographic centroid imputation had implications in health care research. So, this study used centroid points rather than patients address in distance calculation. A centroid point at Dong was made by feature to point function in ArcGIS 9.3. It created a point feature based on Dong polygon features class.

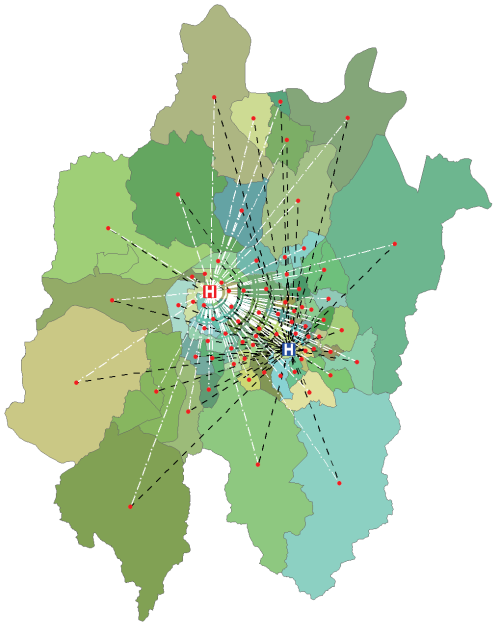

FIGURE 2. Measuring distance from hospitals to the centroid points at Dong

2.3 Control variables

Variables representing socio-economic status of people in each dong were used to control the differences of characteristics of areas. Those selected variables were assumed to influence the health care demand (Folland, Goodman, Stano, 1997). Seven variables were selected: (1) population, (2) number of people aged over 65, (3) number of female, (4) number of basic livelihood security recipients, (5) number of establishments, (6) number of workers, and (7) number of passenger cars per 1,000 population in each ward office. Data for those factors were come from the annual report of the 5 ward offices in Daejeon in 2008. As the annual report did not have data for the number of passenger cars per 1,000 population in each ward office at Dong level, its data calculated based on ward office level.

2.4 Analysis methods

Descriptive analysis was performed to analyze the distribution of study variables. Second, correlation analysis was performed to identify the relationships among variables. Third, multivariate regression analysis was applied to analyze the effects of distance on the patients' visits after controlling the differences of socio-economic status of areas. Four regression models were developed.

3. Results

In Table 1, hospital (A) showed longer average distance (5514.2 m) compare to that (5019.4 m) of hospital (B). It seems that hospital (B) is on better location than hospital (A) simply based on the distance variable.

TABLE 1. Descriptive statistics of distance values
unit: m

Distance	Average (STD)
Distance from hospital(A) to the centroid of Dong	5514.2 (3007.4)
Distance from hospital(B) to the centroid of Dong	5019.4 (3634.5)

Table 2 provided the statistics of socio-economic variables in Dong. The average (standard deviation) number of population was 17,306.5 (8,644.8). N of people aged over 65 years showed average of 1,726.1 and standard deviation is 985.5. Number of basic livelihood security recipients and number of workers showed large standard deviation.

In Table 3, hospital (A) showed higher number of patient visits compare to hospital (B). Two hospitals showed large difference in the number of outpatient visits compare to the number of inpatient visits.

TABLE 2. Descriptive statistics of control variables

Socio-economic variables	Average(STD)
Population	17,306.5 (8,644.8)
N of people aged over 65	1,726.1 (985.5)
N of female	8,622.6 (4,353.0)
N of basic livelihood security recipients	5,353.9 (5,328.5)
N of Establishments	1,122.4 (696.1)
N of workers	541.5 (504.3)
N of passenger cars per 1,000 population in each ward	262.0 (29.5)

TABLE 3. Descriptive statistics of patient visits

Hospital	Average (STD)
N of inpatients (A)	15.8 (18.2)
N of outpatients (A)	1,069.5 (1,463.2)
N of inpatients (B)	14.3 (10.1)
N of outpatients (B)	868.7 (686.5)

Distance from hospital to the centroid of Dong measured by straight line did not have significant correlation coefficients in both hospitals (A) and (B) (Table 4). Number of inpatients showed significant correlation with the number of outpatients in two hospitals.

TABLE 4. Pearson's correlation coefficients (p-value)

	(A)	(B)	(C)	(D)	(E)	(F)
(A)	1					
(B)	-.01 (.95)	1				
(C)	.12 (.30)	.89 (.00)	1			
(D)	.47 (.00)	.03 (.83)	.08 (.48)	1		
(E)	.02 (.84)	.23 (.05)	.28 (.01)	.05 (.65	1	
(F)	-.01 (.90)	.21 (.07)	.28 (.02)	-.05 (.67)	.95 (.00)	1

(A) Distance from hospital (B) to Dong centroid
(B) Number of inpatients who visited to hospital (B) from each Dong
(C) Number of outpatients who visited to hospital (B) from each Dong
(D) Distance from hospital (A) to Dong centroid
(E) Number of inpatients who visited to hospital (A) from each Dong
(F) Number of outpatients who visited to hospital (A) from each Dong

Four regression models were developed to test the effects of distance variable (Table 5). Distance variables were not significant in all four models. Population, number of female, and number of passenger cars per 1,000 population in each ward were significant in models for hospital (A). In hospital (B), number of basic livelihood, and number of passenger cars per 1,000 population in each ward were significant.

4. Discussion

This study examined whether the distance from patients' residence to hospital had influences on the visits to oriental medicine hospitals. The study results showed no significant effects of distances after controlling socio-economic factors of geographical areas. Rather than distance variable, population, number of female, and number of passenger cars per 1,000 population in each ward were significant in explaining the differences of inpatient and outpatient visits from Dongs.

TABLE 5. Standardized regression coefficients

Variables	Hospital (A)		Hospital (B)	
	Inpatient	Outpatients	Inpatient	Outpatients
Distance	-.02	-.11	.05	.18
Population	-7.09*	-8.65*	-2.38	-3.19
N of people aged over 65	-.07	-.08	.15	.19
N of female	7.34*	8.88*	2.70	3.41
N of basic livelihood security recipients	.05	.02	0.25*	.20
N of Establishments	.13	.09	.03	.08
N of workers	.11	.21	.04	.08
N of passenger cars per 1,000 population in each ward	0.28*	.19	-0.42*	-0.43*
F	6.0*	5.7*	3.6*	3.5*
Adj. R2	0.35	0.34	0.22	.21

* $p<0.05$

The study results provide that socio-economic attributes of people explain the choice of service more accurately than the distance factor. This will have good management implications for hospital managers. It implies that people are willing to travel longer distance if they decide to use the service of oriental medicine hospital in a city. Kim (2006) argued that travel distance to hospital were varied by patients' characteristics such as age, length of stay, and disease type. When patients are female or age over 60, they traveled longer distance than others. Therefore, hospital managers will need to find appropriate ways to focus target people with specific attributes in order to increase the hospital visits.

This study measured distance with the Euclidean straight-line between hospital facility and patients' Dong centroid. If shortest-path drive distance were applied in the analysis, different results could be provided. It will need to compare not only the distances measured by two methods, but also the effects on patients' visit.

The results were limited by sample size. Only data from two oriental hospitals in a city were included in the analysis. The generalizability of results was limited. Future study will need to expand the number of hospitals.

5. Conclusions

The study findings help to expand the complex relationship among distance, socio-economic status of people, and patients visits to oriental medicine hospitals.

Study results showed that unlike the previous studies analyzing the visits to western hospitals, distance to hospital from patients' residences did not have significant influences on the patients' decisions whether to use the services of oriental medicine hospital. This will imply that people will visit oriental medicine hospitals regardless to the spatial distances.

Significant effects of socio-economic status of people on the number of visits will provide implications for the future marketing activities in the hospitals. Based on the study results, target areas for marketing could be selected such as where the demand of services was low compare to other areas, or who should be focused on CRM activities.

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