

Imbalance in Cardiovascular Surgery Medical Service Use Between Regions

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Background: This study uses the relevance index to understand the condition of regional medical service use for cardiovascular surgery and to identify the medical service use imbalance between regions. **Methods:** This study calculated the relevance index of 16 metropolitan cities and provinces using resident registration address data from the Ministry of Government Administration and Home Affairs and the 2010–2014 health insurance, medical care assistance, and medical benefits claims data from the Health Insurance Review and Assessment Service. We identified developments over the 5-year time period and analyzed the level of regional imbalance regarding cardiovascular surgery through the relative comparison of relevance indexes between cardiovascular and other types of surgery. **Results:** The relevance index was high in large cities such as Seoul, Daegu, and Gwangju, but low in regions that were geographically far from the capital area, such as the Gangwon and Jeju areas. Relevance indexes also fell as the years passed. Cardiovascular surgery has a relatively low relevance index compared to key types of surgery of other fields, such as neurosurgery and colorectal surgery. **Conclusion:** This study identified medical service use imbalance between regions for cardiovascular surgery. Results of this study demonstrate the need for political intervention to enhance the accessibility of necessary special treatment, such as cardiovascular surgery.

Key words: 1. Cardiovascular surgery
2. Medical service use
3. Relevance index
4. Difference

Introduction

Cardiovascular disease has a high mortality rate and a high burden of medical expenses. It has become an important healthcare issue commensurate with a rap-

id aging population. Emphasis is growing on efficient function and the role of the healthcare system in order to prevent, manage, and treat cardiovascular disease [1]. In particular, because cardiovascular surgery is a field that integrates advanced techniques and

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professionalized human resources, it is a field where medical service use in the context of an efficient healthcare system is important [2].

Treatment of cardiovascular surgery is difficult, requires professional care, and is directly related to patient life. Citizens should be provided with accessible, high-quality medical service along with appropriate medical resources. However, cardiovascular surgery occurs in low frequency and is resource-intensive, which makes resource supply difficult. Due to these reasons, the concentration of cardiovascular surgery treatment in the capital area has been intensifying. Approximately 60% of medical institutions providing cardiovascular surgery are distributed in the capital area [3], and the number of patients who receive specialized healthcare in large medical institutions in the capital area is steadily increasing. Citizens prefer large medical institutions for serious and important medical care, such as surgery [4].

When medical use or medical resources are concentrated in a particular region, it negatively affects the health results, because surgical procedures for patients with cardiovascular disease who need prompt treatment may become delayed. It also increases the hidden costs needed to move to another region to receive treatment. Due to this, accessibility issues arise between regions regarding medical service use, and imbalance occurs for the burden of expenses. Therefore, efforts must be made to enhance the level of regional healthcare and solve the regional gap of medical service use.

There little research with objective data on actual regional medical service use for cardiovascular surgery. The main purpose of this study is to use the relevance index to understand the condition of regional medical service use for cardiovascular surgery and identify the medical service use imbalance between regions. Results will provide preliminary data on policy intervention for the alleviation of cardiovascular surgery concentration between regions and enhancement of accessibility.

Methods

This study used the relevance index to compare and identify the medical service use imbalance between regions for cardiovascular surgery. We used patient treatment records (2010–2014) from the health in-

urance, medical care assistance, and medical benefits claims data of the Health Insurance Review and Assessment Service, and resident registration address data from the Ministry of Government Administration and Home Affairs. Cardiovascular surgery included congenital malformation heart surgery, cardiovascular valve surgery, coronary artery surgery, aorta and branch vessel surgery, and heart transplants. Each surgery was assessed by specialists of the department of thoracic and cardiovascular surgery and defined using medical benefits claims codes.

The basic unit of analysis is the 16 metropolitan city and provinces unit (Sejong City is included in the South Chungcheong Province) divided by administrative districts. Relevance index was used in order to identify the medical service use imbalance between regions regarding cardiovascular surgery. The relevance index is also known as the self-sufficiency degree (rate). Using this index, the flow (outflow) of patients actually using regional medical services can be reflected to identify the level of accessibility of the region. Out of the total amount of medical service use by a patient residing in a region, the relevance index is the percentage of the use of medical institutions within the selected region. The relevance index formula is as follows [5]:

$$\text{(Relevance index formula)} \quad RI_i = n_{ii} / \sum_j n_{ij}$$

n_{ij} is the number of operations that patients residing in the i region undergo at medical institutions located in the j region.

In this formula, when patients residing in i region use medical institutions within that region, $i = j$, which becomes the self-sufficiency rate, and using this rate, the outflow of patients in the region to other regions can be identified [6]. If the self-sufficiency rate is high for a certain region regarding cardiovascular surgery, it means the rate of patients in that region using medical services within the region is high, and the rate of patients moving to other regions is low.

To analyze the relevance index, developments over the five years from 2010 to 2014 were identified for the 16 metropolitan cities and provinces. The level of regional imbalance regarding cardiovascular surgery use was identified through the relative comparison of relevance indexes between cardiovascular surgery and other types of surgery (e.g., neurosurgery, colorectal

Table 1. Cases of hospitalization for different types of cardiac surgery, by year

| Classification | Year | | | | |
|--|----------------|----------------|----------------|----------------|----------------|
| | 2010 | 2011 | 2012 | 2013 | 2014 |
| No. of cardiac surgery patients | 10,673 | 10,451 | 10,585 | 10,413 | 10,418 |
| No. of hospitalization cases for cardiac surgery | | | | | |
| Total | 10,814 (100.0) | 10,600 (100.0) | 10,739 (100.0) | 10,585 (100.0) | 10,581 (100.0) |
| Congenital cardiac surgery | 2,564 (23.7) | 2,537 (23.9) | 2,566 (23.9) | 2,549 (24.1) | 2,443 (23.1) |
| Valves surgery | 2,626 (24.3) | 2,591 (24.4) | 2,627 (24.5) | 2,699 (25.5) | 2,626 (24.8) |
| Coronary artery surgery | 2,825 (26.1) | 2,711 (25.6) | 2,706 (25.2) | 2,437 (23.0) | 2,565 (24.2) |
| Aorta and branch vessel surgery | 1,331 (12.3) | 1,324 (12.5) | 1,362 (12.7) | 1,339 (12.7) | 1,317 (12.5) |
| Heart transplantation | 71 (0.7) | 88 (0.8) | 106 (1.0) | 117 (1.1) | 106 (1.0) |
| Valves and coronary artery surgery | 341 (3.2) | 300 (2.8) | 302 (2.8) | 291 (2.8) | 308 (2.9) |
| Other | 1,056 (9.8) | 1,049 (9.9) | 1,070 (10.0) | 1,153 (10.9) | 1,216 (11.5) |

Values are presented as number (%).

Table 2. Relevance index of cardiac surgery by region (%)

| Regions | Year | | | | |
|-----------|------|------|------|------|------|
| | 2010 | 2011 | 2012 | 2013 | 2014 |
| Average | 36.3 | 35.9 | 36.4 | 37.2 | 36.7 |
| Seoul | 94.0 | 93.8 | 93.7 | 92.9 | 91.8 |
| Gyeonggi | 34.9 | 33.8 | 33.8 | 38.7 | 42.0 |
| Incheon | 32.6 | 23.1 | 34.7 | 32.9 | 32.7 |
| Gangwon | 19.0 | 18.5 | 21.6 | 18.5 | 15.4 |
| Chungbuk | 6.0 | 9.8 | 4.7 | 5.5 | 5.9 |
| Chungnam | 7.7 | 5.9 | 3.0 | 5.5 | 8.8 |
| Daejeon | 38.6 | 35.7 | 35.7 | 41.0 | 35.6 |
| Jeonbuk | 43.2 | 43.7 | 42.9 | 41.1 | 42.9 |
| Jeonnam | 18.6 | 21.5 | 18.7 | 22.2 | 15.4 |
| Gwangju | 38.1 | 45.9 | 50.8 | 57.1 | 61.6 |
| Gyeongbuk | 0.0 | 0.0 | 1.1 | 0.2 | 0.0 |
| Daegu | 76.8 | 73.6 | 70.9 | 75.3 | 76.9 |
| Gyeongnam | 40.9 | 42.9 | 41.0 | 43.3 | 45.5 |
| Busan | 48.2 | 49.3 | 51.3 | 47.9 | 51.0 |
| Ulsan | 45.9 | 46.0 | 42.1 | 41.8 | 36.0 |
| Jeju | 36.9 | 31.1 | 35.7 | 30.8 | 26.4 |

surgery, gastrectomy, and hysterectomy). For neurosurgery and colorectal surgery, data were categorized for neurosurgery and colorectal surgery by the diagnosis-related group codes from the health insurance, medical care assistance, and medical benefits claims data were used from the Health Insurance Review and Assessment Service. For gastrectomy and hysterectomy, data were used from the 2014 statistical yearbook of key operations from the National Health Insurance Corporation.

Results

1) The use of medical services for cardiovascular surgery by year

The number of annual cardiovascular surgery patients in 2014 was 10,418, which was a relative decrease compared to 10,673 in 2010. The number of annual hospitalizations due to cardiovascular surgery in 2014 was 10,581, and of these, congenital malformation heart surgery and cardiovascular valve surgery made up more than 70% of the total number of operations. The number of hospitalizations also decreased compared to the 10,814 cases in 2010 (Table 1).

2) Relevance index by region

Based on 2014 records, the average regional relevance index was 36.7%, 91.8% for the Seoul area, 76.9% for the Daegu area, and 61.6% for the Gwangju area, which demonstrated that residents used local medical services for cardiovascular surgery in metropolitan areas. On the other hand, the relevance index was low for the following regions: 0.0% for the North Gyeongsang area, 5.9% for the North Chungcheong area, 15.4% for the Gangwon area, 15.4% for the South Jeolla area, and 26.4% for the Jeju area.

Examining the relevance index by year, while the 2014 relevance index for Seoul decreased compared to that of 2010, the relevance index for the neighboring Gyeonggi area increased from 34.9% in 2010 to 42.0% in 2014. In the Gwangju area, the relevance index increased from 38.1% in 2010 to 61.6% in 2014. In the Daegu area, the relevance index decreased from 76.8% in 2010 to 70.4% in 2012 then increased

Table 3. 2014 relevance index by surgery type (%)

| | Surgery type | | | | |
|----------------------------|-----------------|--------------|--------------------|-------------|--------------|
| | Cardiac surgery | Neurosurgery | Colorectal surgery | Gastrectomy | Hysterectomy |
| Average of relevance index | 36.7 | 62.7 | 55.8 | 49.9 | 72.5 |

From Health Insurance Review and Assessment Service; Ministry of the Interior; National Health Insurance Service.

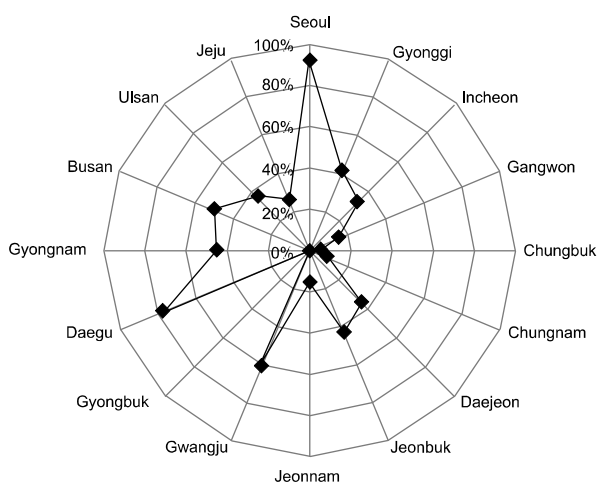


Fig. 1. Relevance index of cardiac surgery.

to 76.9% in 2014. In the Busan area, the relevance index decreased from 48.2% in 2010 to 47.9% in 2013 and then increased to 51.0% in 2014. With the exception of Ulsan, the relevance index regarding cardiovascular surgery in metropolitan cities maintained at a similar level from year to year, or increased slightly. In particular, there was a great increase in the Gwangju area. However, the relevance index steadily decreased for the Gangwon area (19.0% in 2010 to 15.4% in 2014) and the Jeju area (36.9% in 2010 to 26.4% in 2014) (Table 2).

3) Comparison between cardiovascular surgery and other types of surgery

Compared to other types of surgery, the relevance index for cardiovascular surgery was low. When compared against the average relevance index of the 16 metropolitan cities and provinces, the relevance index for cardiovascular surgery was 36.7%, while the relevance index was 62.7% for neurosurgery, 55.8% for colorectal surgery, 49.9% for gastrectomy, and 72.5% for hysterectomy (Table 3, Figs. 1 and 2).

Discussion

This study calculated the relevance index by region in order to identify the medical service use imbalance between regions for cardiovascular surgery. The relevance index is an indicator that shows the actual outflow pattern of medical service use by patients in the region. Analysis of the 2010–2014 relevance index of cardiovascular surgery patients revealed that the relevance index was high in large cities like Seoul, Daegu, and Gwangju but low in regions that were geographically far from the capital area, such as the Gangwon and Jeju areas. The relevance index also decreased during the study time period for regions with low relevance indexes.

The relevance index can identify how many patients have used medical institutions within the region and at the same time reflect the condition of medical service use within the region by assessing whether or not patients traveled to another region to use medical services, rather than services in their residential region [7]. If the relevance index is high, it means the demand for medical services is mostly satisfied within the region and that the move to other regions is relatively low. The results of this study show that geographical accessibility for cardiovascular surgery patients was very low in regions other than large cities such as Seoul, Daegu, Gwangju, and Busan. Moreover, the relevance index for cardiovascular surgery was lower than the relevance index for other fields such as neurosurgery, colorectal surgery, gastrectomy, and hysterectomy. These results are similar to those of previous studies on cancer (a representative acute disease), which showed that the 1999 and 2002 relevance index for cancer patients was high in Seoul, Daegu, and Busan, in that respective order [7]. The studies concluded that these results were due to the concentration of medical institutions in those regions.

Kim et al. [6] found that the regional difference between medical service use differs according to dis-

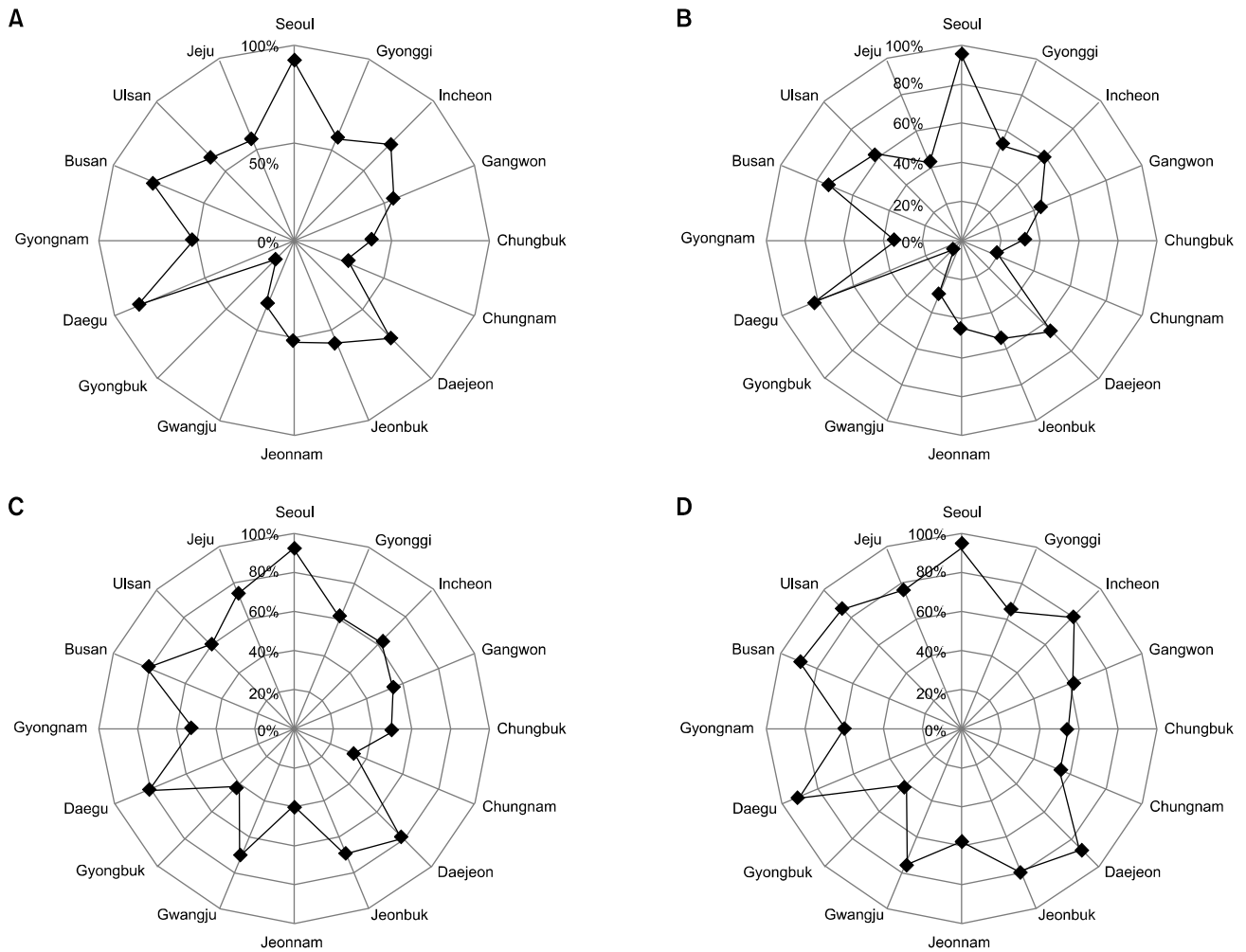


Fig. 2. 2014 Relevance indexes of (A) colorectal surgery, (B) gastrectomy, (C) neurosurgery, and (D) hysterectomy.

ease characteristics. In general, the farther the distance to the medical institution that provides the necessary services, the more the use of medical services decreases, but this scenario differs according to the acuteness of the disease [8,9]. For highly acute diseases such as acute mental illnesses and cancer, the use of medical services does not decrease as much even if the distance increases [6]. Acute disease patients must use medical services even if they must travel to a region afar, so accessibility is very important for acute disease patients.

Reinforcement of cardiovascular surgery functions within regions is needed. Cardiovascular surgery is relatively less selective than cancer and it is harder for patients to travel to another region because cardiovascular surgery more often requires emergency

care. Timing in cardiovascular surgery is a very important factor that affects the mortality rate because services must be provided within a short time after the symptoms occur, and in order to enhance health results, patients must be transported and cared for in the early stages [10]. The concentration of cardiovascular operations in a few large cities indicates that it is more difficult for cardiovascular surgery patients residing in provinces to receive cardiovascular operations in time, compared to those living in large cities. These results highlight the need for policies that will reinforce the treatment functions of cardiovascular operations in the provinces.

A limitation of this study is that it does not provide a definite cause for the increase and decrease of the relevance index by region. It is predicted that scar-

city of medical resources between regions and the preferences of the residents in the region will affect the relevance index. Because influence factors and the degree of influence may vary depending on regional characteristics, additional research is needed.

In conclusion, the significance of a balanced use of regional medical services means guaranteed accessibility based on needs and enhancement of treatment opportunities, which in turn influence the health results of patients. This study identified medical service use imbalance between regions could be for cardiovascular surgery, which suggests the need for policy intervention in order to enhance accessibility to necessary special treatment.

Conflict of interest

No potential conflicts of interest relevant to this article are reported.

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