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Domestic medical travel from non-Seoul regions to Seoul for initial breast cancer treatment: a nationwide cohort study

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Purpose: This study was conducted to investigate the trend of domestic medical travel from non-Seoul areas to Seoul for initial breast cancer treatment, and identify factors associated with medical travel in breast cancer patients.
Methods: A nationwide retrospective cohort study was performed using the Health Insurance Review and Assessment data of South Korea. Patients were classified according to the regions in which they underwent breast biopsy (Seoul *vs.* metropolitan cities *vs.* other regions). Frequencies of biopsy, diagnosis, treatment, and domestic medical travel were analyzed according to regions, and factors associated with medical travel were investigated.
Results: A total of 150,709 breast cancer survivors who were diagnosed between January 2010 and December 2017 were included. The total rate of medical travel from non-Seoul regions to Seoul had increased from 14.2% (1,161 of 8,150) in 2010 to 19.8% (2,762 of 13,964) in 2017. Approximately a quarter of patients from other regions traveled to Seoul, and over 40% of patients from Chungbuk, Gyeongbuk, and Jeju regions traveled to Seoul for initial treatment in 2017. The difference in the annual frequencies of upfront surgery between Seoul and non-Seoul regions increased over time. Younger age and regions other than metropolitan cities were significantly related to medical travel. Patients covered by medical aid or past medical histories were significantly less likely to travel to Seoul for initial breast cancer treatment.
Conclusion: Medical travel to Seoul for upfront breast cancer surgery is increasing. Policies for appropriate healthcare delivery need to be established in the near future.
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Key Words: Breast neoplasms, Drug therapy, Radiotherapy, Surgery, Travel

INTRODUCTION

The incidence of breast cancer has rapidly increased and breast cancer has become the major type of cancer among women worldwide [1,2]. In South Korea, more than 26,000 patients were newly diagnosed with breast cancer in 2017 [3], which led to increased demands for breast cancer surgery and other adjuvant treatments [4].

Multidisciplinary approaches and timely access to definitive care are important for improving breast cancer outcomes [5-7]. There is substantial evidence that a treatment delay of 3 months or more in breast cancer patients is associated with a lower survival rate [5]. One of the factors that can affect delay in treatment is domestic medical travel, which is moving from

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one region to other regions for treatment.

Studies on domestic medical travel have been conducted primarily for cancers other than breast cancer [8-10]. In South Korea, medical travel from non-capital regions to Seoul for cancer treatments has been increasing [11-13]. However, little is known about the trend of medical travel for breast cancer patients in South Korea. Therefore, we conducted a nationwide retrospective cohort study using the national claims data to investigate the patterns and frequencies of initial breast cancer treatments by region, assess domestic medical travel over time, and identify the factors associated with medical travel in breast cancer patients.

METHODS

This study was approved by the Institutional Review Board of Asan Medical Center (No. 2020-1769). It was performed in accordance with the Declaration of Helsinki and written informed consent was waived due to its retrospective nature.

Data source and extraction

The Health Insurance Review and Assessment (HIRA) assesses the medical services provided in South Korea and determines their reimbursement. Accordingly, the HIRA database archives the nationwide claims data from all healthcare providers and provides the data in 6 domains including general information, healthcare services, prescriptions, diagnosis, medication information, and provider information [14]. The diagnosis data is archived using the International Classification of Diseases, 10th revision (ICD-10). The V193 code is a specialized claim code for reimbursement based on which hospitals are reimbursed for cancer treatment by the Korean government.

Study population

We extracted all available data of 254,796 patients who were coded with the ICD-10 C50 and V193 codes between January 2010 and December 2017. To exclude prevalent cases, we discarded cases between January 2008 and December 2009 (n = 87,646). A total of 167,150 newly diagnosed breast cancer patients were identified. Of them, we excluded cases of male breast cancer (n = 1,214), history of ductal carcinoma in situ (n = 3,937), recurrent breast cancer (n = 2,642), absence of previous diagnostic biopsy (n = 8,495), absence of follow-up record (n = 152), and absence of the record of the medical facility where the biopsy was performed (n = 1) (Fig. 1).

Variables and operational definitions

The basic demographics of the patients and their Charlson comorbidity index (CCI) using ICD-10 codes were analyzed [15]. Medical histories such as hypertension (I10–13, 15), diabetes mellitus (E10–14), and dyslipidemia (E78) were defined using the relevant ICD-10 codes combined with medications.

Biopsy for breast cancer diagnosis was defined with the pathologic examination claims codes (C5509, C5911–C5917, C5500, C5504, C5508). The date of biopsy was defined as the latest date among the dates when pathologic exam claims codes were recorded prior to breast cancer diagnosis. The date of breast cancer diagnosis was defined as the first date when C50 plus V193 codes were recorded. Surgery, chemotherapy, radiotherapy, endocrine therapy, and trastuzumab were defined based on the claims data recorded within 1 year after diagnosis.

Geographic regions were categorized into Seoul, metropolitan cities (Daegu, Daejeon, Gwangju, Incheon, Busan, and Ulsan), and other regions (Chungbuk, Chungnam, Gangwon, Gyeongbuk, Gyeonggi, Gyeongnam, Jeju, Jeonbuk, Jeonnam,

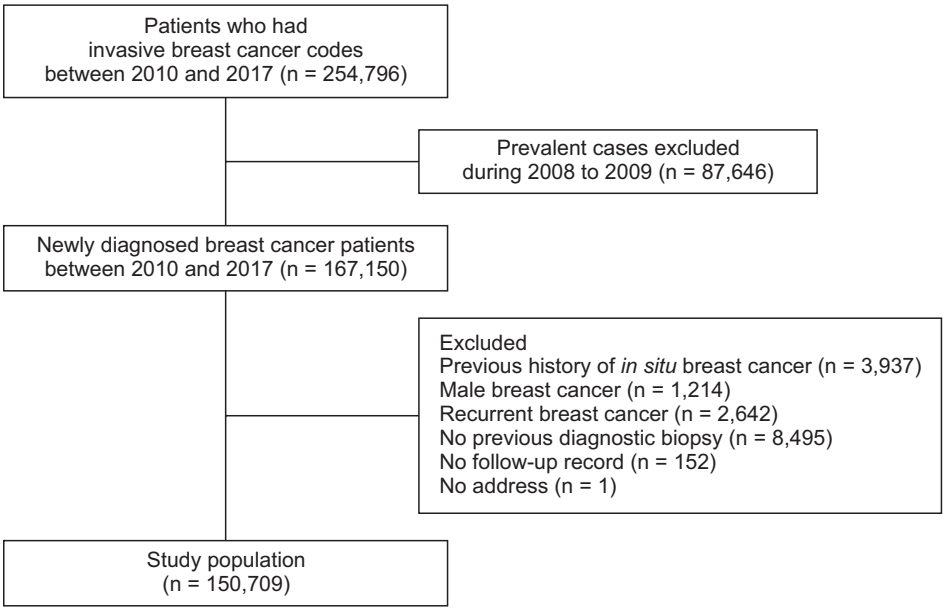

Fig. 1. Study enrollment.

and Sejong). Subjects were classified into 3 groups according to the regions in which they underwent biopsy.

Statistical analysis

Baseline characteristics were presented according to the regions where biopsy was performed. The annual frequencies of biopsy, diagnosis, and initial treatment (surgery, chemotherapy, and radiation) for breast cancer by geographic region were analyzed. The numbers and proportions of patients who underwent biopsy in non-Seoul areas traveling to Seoul for initial breast cancer treatment were analyzed. Factors associated with domestic medical travel from non-Seoul regions to Seoul were analyzed using a multivariable logistic regression model adjusted by age at diagnosis, insurance (health insurance *vs.* medical aid), CCI, region where the pathologic exam was performed (metropolitan cities *vs.* other regions), and year (from 2010 to 2017).

Statistical analyses were conducted using SAS software ver. 9.4.2 (SAS Institute) and R software ver. 3.5.1 (R Foundation for Statistical Computing; http://www.r-project.org).

RESULTS

Baseline characteristics

A total of 150,709 patients diagnosed with breast cancer between January 2010 and December 2017 were included in this analysis (Table 1). Of the patients, 135,886 (90.2%) underwent surgery. The proportions of breast cancer patients who received chemotherapy and radiotherapy were 58.4% and 66.4%, respectively. During the study period, 60,542 (40.2%) patients were diagnosed with breast cancer in Seoul.

Annual frequencies of pathologic exams, diagnosis, and treatment by regions

From 2010 to 2017, the annual frequencies of pathologic exams, diagnosis, and treatment for breast cancer increased in all regions (Fig. 2). The difference in the annual frequencies of pathologic examination and diagnosis between Seoul and other regions decreased over time (Fig. 2A, B). However, the difference in the annual frequencies of initial treatment and surgery between Seoul and non-Seoul regions increased over time (Fig. 2C, D). The difference in the annual frequencies of chemotherapy and radiotherapy between Seoul and non-Seoul regions did not increase over time (Fig. 2E, F).

Domestic medical travel for breast cancer treatment

Among the patients who underwent biopsy in non-Seoul regions, after excluding 434 patients without a record on the date of pathologic exam, the rate of domestic medical travel from non-Seoul regions to Seoul for initial treatment increased from 14.2% (1,161 of 8,150) in 2010 to 19.8% (2,762 of 13,964) in 2017 (Table 2). Approximately a quarter of patients (23.6%) from other regions traveled to Seoul in 2017. Especially, more than 40% of breast cancer patients who underwent biopsies in Chungbuk, Gyeongbuk, and Jeju regions traveled to Seoul in 2017 (Fig. 3).

Factors associated with domestic medical travel for breast cancer treatment

After excluding 4,171 patients who did not receive any treatment, multivariable logistic regression analyses showed age younger than 40 years (adjusted odds ratio [OR], 2.13; 95% confidence interval [CI], 2.00–2.28; $P < 0.001$) was significantly associated with a higher likelihood for domestic medical

Table 1. Characteristics of the study population

Characteristic	Seoul	Metropolitan cities	Other regions	Total
No. of patients	60,542	40,893	49,274	150,709
Age at diagnosis (yr)	51.6 ± 11.3	52.4 ± 11.2	52.3 ± 11.7	52.0 ± 11.4
Insurance				
Health insurance	59,228 (97.8)	39,105 (95.6)	47,391 (96.2)	145,724 (96.7)
Medical aid	1,314 (2.2)	1,788 (4.4)	1,883 (3.8)	4,985 (3.3)
Charlson comorbidity index	2.2 ± 2.1	2.3 ± 2.1	2.3 ± 2.1	2.3 ± 2.1
Previous diabetes mellitus	5,343 (8.8)	4,070 (10.0)	5,218 (10.6)	14,631 (9.7)
Previous hypertension	16,042 (26.5)	11,734 (28.7)	14,728 (29.9)	42,504 (28.2)
Previous dyslipidemia	15,931 (26.3)	11,593 (28.3)	13,771 (27.9)	41,295 (27.4)
Surgery	54,083 (89.3)	37,407 (91.5)	44,396 (90.1)	135,886 (90.2)
Chemotherapy	33,984 (56.1)	24,491 (59.9)	29,466 (59.8)	87,941 (58.4)
Radiotherapy	39,799 (65.7)	26,667 (65.2)	33,598 (68.2)	100,064 (66.4)
Endocrine therapy	39,735 (65.6)	27,016 (66.1)	33,351 (67.7)	100,102 (66.4)
Trastuzumab	8,756 (14.5)	7,000 (17.1)	7,786 (15.8)	23,542 (15.6)
Duration after cohort entry (mo)	51 (29–77)	49 (28–74)	46 (26–71)	49 (28–74)

Values are presented as number only, mean ± standard deviation, number (%), or median (interquartile range).

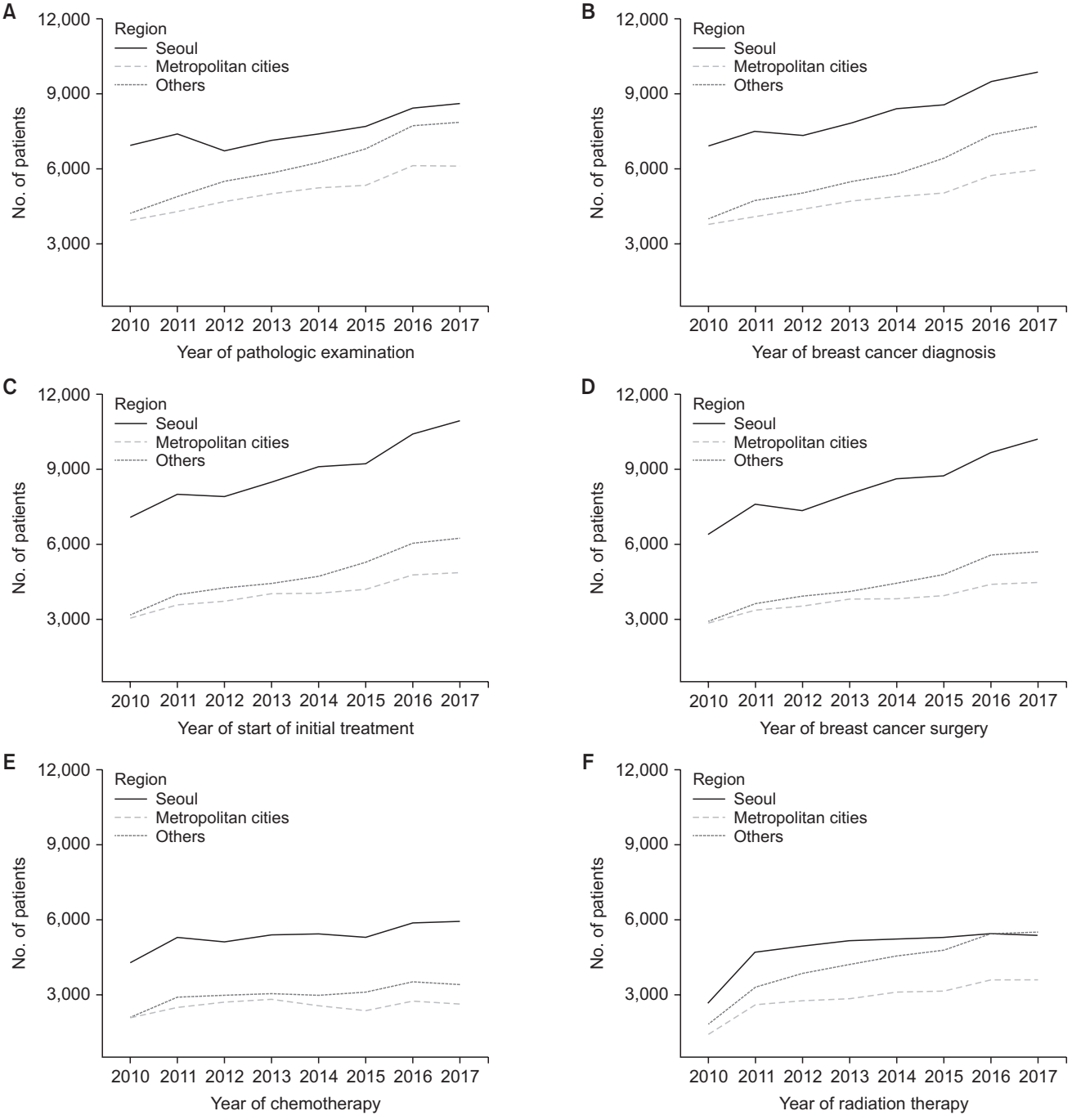

Fig. 2. Annual number of patients according to procedures and treatments by region. (A) Pathologic examination. (B) Diagnosis. (C) Initial treatment. (D) Breast cancer surgery. (E) Chemotherapy. (F) Radiotherapy.

travel to Seoul for breast cancer treatment (Table 3). Patients registered with medical aid (OR, 0.26; 95% CI, 0.23–0.31; P < 0.001) and those with other medical diseases (OR, 0.98; 95% CI, 0.97–0.99; P < 0.001) were significantly less likely to travel to Seoul. Patients who underwent pathologic examination in other regions were significantly more likely to travel to Seoul than those who underwent an examination in metropolitan cities (OR, 1.77; 95% CI, 1.71–1.84; P < 0.001).

DISCUSSION

This study showed that domestic medical travel for breast cancer treatment from non-Seoul regions to Seoul increased over time in South Korea. In some regions, more than 40% of the patients traveled to Seoul for breast cancer treatment in 2017. Young patients and patients in other regions were more likely to travel to Seoul after biopsy. Patients covered by medical

Table 2. Domestic medical travel from non-Seoul regions to Seoul for initial treatment (2010–2017)

Variable	2010			2011			2012			2013			2014			2015			2016			2017			Total		
	n[a]	n[b]	%	n[a]	n[b]	%	n[a]	n[b]	%	n[a]	n[b]	%	n[a]	n[b]	%	n[a]	n[b]	%	n[a]	n[b]	%	n[a]	n[b]	%	n[a]	n[b]	%
Metropolitan city	3,935	443	11.3	4,286	432	10.1	4,692	624	13.3	4,992	696	13.9	5,232	803	15.3	5,339	735	13.8	6,128	874	14.3	6,105	906	14.8	40,709	5,513	13.5
Other regions	4,215	718	17.0	4,873	796	16.3	5,495	1,190	21.7	5,818	1,326	22.8	6,240	1,529	24.5	6,797	1,468	21.6	7,727	1,758	22.8	7,859	1,856	23.6	49,024	10,641	21.7
Total	8,150	1,161	14.2	9,159	1,228	13.4	10,187	1,814	17.8	10,810	2,022	18.7	11,472	2,332	20.3	12,136	2,203	18.2	13,855	2,632	19.0	13,964	2,762	19.8	89,733	16,154	18.0
Region																											
Chungbuk	183	57	31.1	197	61	31.0	269	99	36.8	247	113	45.7	289	126	43.6	350	146	41.7	352	141	40.1	297	122	41.1	2,184	865	39.6
Chungnam	215	53	24.7	248	44	17.7	281	62	22.1	298	71	23.8	297	87	29.3	381	96	25.2	409	107	26.2	386	98	25.4	2,515	618	24.6
Daegu	902	63	7.0	970	70	7.2	1,027	98	9.5	1,139	116	10.2	1,220	123	10.1	1,257	118	9.4	1,339	136	10.2	1,362	159	11.7	9,216	883	9.6
Daejeon	441	80	18.1	469	74	15.8	568	150	26.4	520	133	25.6	617	181	29.3	615	163	26.5	741	187	25.2	673	167	24.8	4,644	1,135	24.4
Gangwon	219	60	27.4	236	57	24.2	292	100	34.2	325	102	31.4	341	117	34.3	369	108	29.3	435	134	30.8	444	130	29.3	2,661	808	30.4
Gwangju	323	48	14.9	380	39	10.3	440	75	17.0	522	93	17.8	485	91	18.8	497	72	14.5	604	110	18.2	655	127	19.4	3,906	655	16.8
Gyeongbuk	166	49	29.5	218	72	33.0	284	97	34.2	288	99	34.4	307	132	43.0	340	148	43.5	395	168	42.5	406	178	43.8	2,404	943	39.2
Gyeonggi	2,358	326	13.8	2,793	381	13.6	3,105	568	18.3	3,302	613	18.6	3,614	716	19.8	3,758	612	16.3	4,347	778	17.9	4,506	889	19.7	27,783	4,883	17.6
Gyeongnam	307	48	15.6	367	55	15.0	377	82	21.8	451	116	25.7	470	123	26.2	570	133	23.3	634	158	24.9	687	167	24.3	3,863	882	22.8
Incheon	645	71	11.0	684	72	10.5	783	106	13.5	837	131	15.7	849	132	15.5	952	141	14.8	1,148	150	13.1	1,113	138	12.4	7,011	941	13.4
Jeju	68	24	35.3	89	27	30.3	117	34	29.1	127	44	34.6	132	45	34.1	158	53	33.5	156	56	35.9	190	80	42.1	1,037	363	35.0
Jeonbuk	367	55	15.0	415	57	13.7	436	91	20.9	442	96	21.7	447	115	25.7	502	105	20.9	596	134	22.5	561	110	19.6	3,766	763	20.3
Jeonnam	332	46	13.9	310	42	13.5	334	57	17.1	336	71	21.1	343	68	19.8	368	66	17.9	401	82	20.4	381	82	21.5	2,805	514	18.3
Busan	1,442	160	11.1	1,572	147	9.4	1,642	157	9.6	1,713	196	11.4	1,712	224	13.1	1,724	201	11.7	1,904	237	12.4	1,884	242	12.8	13,593	1,564	11.5
Sejong	NA	NA		NA	NA		NA	NA		2	1	50.0	NA	NA		1	1	100	2	0	0	1	0	0	6	2	33.3
Ulsan	182	21	11.5	211	30	14.2	232	38	16.4	261	27	10.3	349	52	14.9	294	40	13.6	392	54	13.8	418	73	17.5	2,339	335	14.3

NA, not available.
[a]Number of patients who underwent pathologic examination, [b]number of patients who got initial treatment in Seoul.

aid or those with other medical diseases were less likely to travel to Seoul. To our knowledge, this is the first nationwide study to investigate the trend in domestic medical travel of breast cancer patients in South Korea.

A previous study showed the medical travel to Seoul for lung cancer surgery in South Korea [11], as the proportion of lung cancer surgeries significantly increased over time in Seoul while the proportion in other areas decreased. For prostate cancer, 1 study showed that the frequencies of medical travel from non-Seoul regions to Seoul for treatment decreased from 2005 to 2014, although a large proportion of medical travel remained unchanged [13]. Another study in the United States was conducted to investigate the impact of centralizing rectal cancer surgeries to high-volume centers [10], which showed that there was a statistically significant increase in the average distance traveled by patients during a 10-year period, indicating that centralization might add to the travel burden of patients.

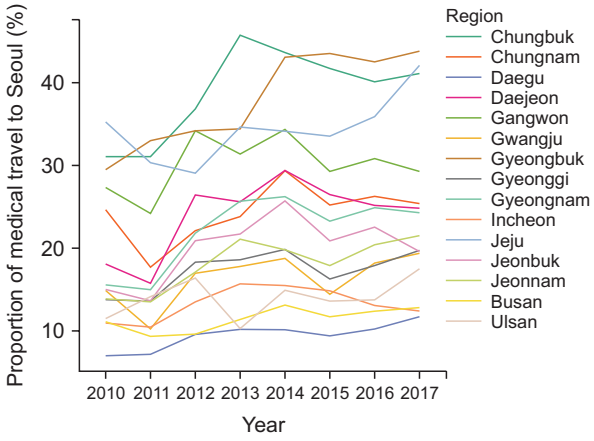

Fig. 3. Annual proportion of medical travel to Seoul by region.

Medical travel for cancer treatment is an important issue for patients and healthcare providers alike because there is a risk of prolonged waiting time for treatment. Delay in the start of treatment often causes anxiety, reduces the quality of life, adversely affects mental health, and may lead to detrimental effects on survival [16]. In breast cancer, prolonged time from diagnosis to surgery may decrease cancer-specific survival as well as overall survival [6,7]. Delayed chemotherapy can be associated with poor prognosis, both in the adjuvant setting [17,18] and in the metastatic setting [19].

The present study describes the patterns of medical travel of more than 150,000 patients diagnosed with breast cancer

Table 3. Factors associated with medical travel from non-Seoul to Seoul using multivariable logistic regression analysis

Factor	No. of cases	No. of events	Proportion (%)	OR (95% CI)	P-value
Age at diagnosis (yr)					
≥60	20,021	2,548	12.7	Reference	
50–59	25,980	4,872	18.8	1.44 (1.37–1.52)	<0.001
40–49	30,310	6,411	21.2	1.65 (1.56–1.74)	<0.001
<40	9,251	2,323	25.1	1.94 (1.82–2.08)	<0.001
Insurance type					
Health insurance	82,243	15,986	19.4	Reference	
Medical aid	3,319	168	5.1	0.26 (0.22–0.31)	<0.001
CCI, continuous	NA	NA	NA	0.99 (0.98–1.00)	0.008
Region					
Metropolitan cities	38,866	5,513	14.2	Reference	
Others	46,696	10,641	22.8	1.75 (1.69–1.81)	<0.001
Year of diagnosis					
2010	7,659	1,161	15.2	Reference	
2011	8,753	1,228	14.0	0.89 (0.81–0.97)	0.010
2012	9,746	1,814	18.6	1.25 (1.15–1.36)	<0.001
2013	10,335	2,022	19.6	1.33 (1.22–1.44)	<0.001
2014	10,927	2,332	21.3	1.50 (1.39–1.63)	<0.001
2015	11,539	2,203	19.1	1.29 (1.19–1.40)	<0.001
2016	13,222	2,632	19.9	1.37 (1.27–1.48)	<0.001
2017	13,381	2,762	20.6	1.42 (1.32–1.54)	<0.001
Initial treatment					
Upfront surgery	71,101	12,569	17.7	Reference	
Neoadjuvant chemotherapy	11,405	3,312	29.0	1.72 (1.64–1.80)	<0.001
Neoadjuvant endocrine therapy	3,056	273	8.9	0.51 (0.44–0.58)	<0.001

OR, odds ratio; CI, confidence interval; CCI, Charlson comorbidity index; NA, not available.

in different regions of South Korea during a 7-year period. We found that young age, insurance type, and previous medical disease were the most important factors associated with medical travel from outside Seoul to Seoul. Medical travel to Seoul for treatment was more common in younger age groups, and the number of patients in their 30s was more than double that of patients aged 60 years or older. A similar trend was also observed in other types of cancers, such as prostate cancer or head and neck cancer [13,20]. In our study, the OR for medical travel in patients on medical aid was 1/4 of that in patients with health insurance. Similar to the results of our study, 1 study conducted on parathyroid surgery in the United States reported that the proportion of domestic medical travelers (defined as patients who underwent parathyroidectomy at a hospital in a different United States region from the one in which they resided and traveled more than 150 miles to that hospital) was higher in patients with insurance (62.1%) than in those with Medicare (32.4%) or Medicaid/uninsured (0.3%) [2].

An interesting finding of the present study is that the proportion of patients receiving initial treatment in Seoul increased over time, but this differed depending on the treatment type (i.e., surgery, chemotherapy, and radiotherapy). The proportion of patients receiving treatment in Seoul increased sharply over time in the case of surgery, while only a modest increase was noted for chemotherapy; in contrast, the proportion of patients receiving radiotherapy increased rapidly in regions other than Seoul. A possible explanation for this discrepancy according to treatment type is the frequency of treatment; while surgery is a 1-time treatment, chemotherapy requires visits every 1–3 weeks for more than 3 months; moreover, radiotherapy requires daily visits, which makes it less likely for patients to travel outside their residential region for treatment.

Breast cancer patients can also travel from Seoul to non-Seoul areas for breast cancer treatment. Fig. 4 demonstrates comprehensive patterns of medical travel for breast cancer treatment. Based on 3 time points (date of pathologic exam following breast biopsy, date of breast cancer diagnosis, and date of initiation of treatment), it shows that compared to proportions of medical travel from non-Seoul to Seoul, those of medical travel from Seoul to metropolitan cities or other areas were low. Interestingly, 5.3% of breast cancer patients did not get any treatment within 1 year after diagnosis.

The Korean government initiated the Regional Cancer Center Support Program in 2004 as regional inequality in cancer care was getting worse. As of today, 12 university hospitals have been designated as Regional Cancer Centers to improve the quality of cancer care in the regions and reduce regional inequalities of cancer treatment in Korea. However, this study showed, despite all these financial supports from the government, medical travel to Seoul for breast cancer treatment has still been increasing. The reason for increasing medical travel to Seoul is not clear. Future studies may be needed to investigate the gaps in treatment quality throughout the centers.

The limitations of this study should be noted. First, the actual address of the patients' residences could not be identified because the HIRA data is based on claims data. Thus, we categorized patients based on the regions where the pathologic examinations were performed instead of the patients' residences. Second, there are several potential factors associated with medical travel that were not included in the HIRA data, such as socioeconomic status, transportation, and route of information. For a more detailed investigation into the reason

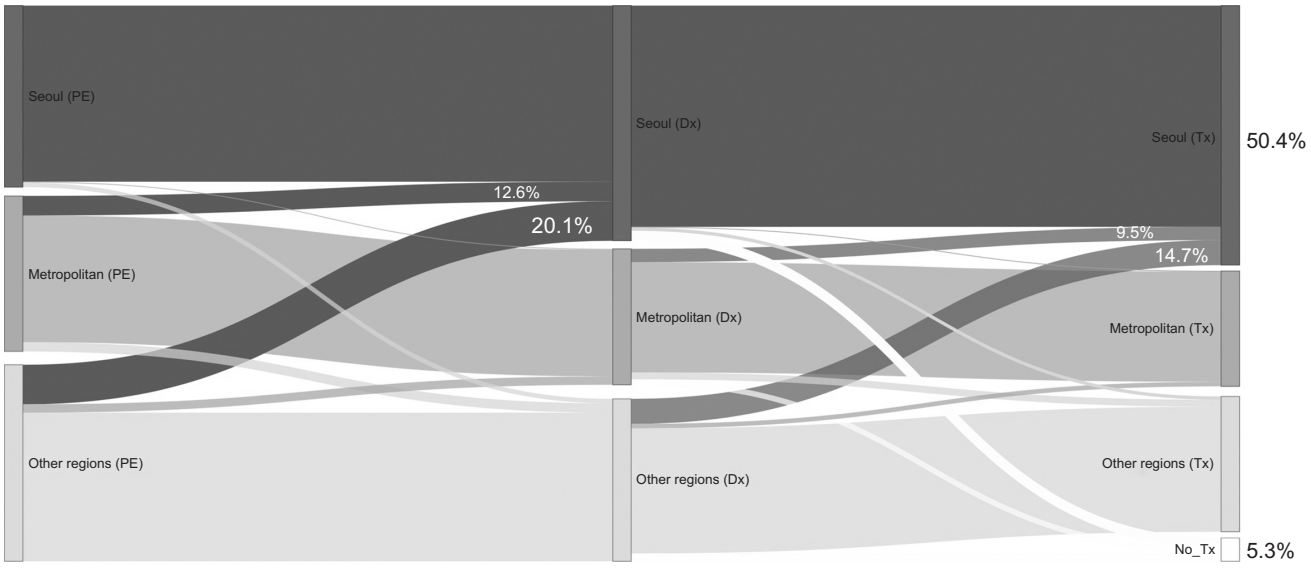

Fig. 4. Comprehensive patterns of medical travel in South Korea. PE, pathologic exam; Dx, diagnosis; Tx, initial treatment.

for medical travel, a subsequent questionnaire study will be conducted. Third, although the present study showed medical travel for breast cancer treatment in South Korea, wait time for breast cancer treatment was not investigated. The issues of medical travel to Seoul for breast cancer treatment are not only just about centralization but also about time delay to treatment and the effect on survival. Further studies are needed to assess whether increased medical travel rates to Seoul lead to delays in treatment and cause harmful effects on breast cancer survival. However, this study is more about inequality of breast cancer treatment between Seoul and non-Seoul areas. The increasing medical travel to Seoul itself indicates the imbalance of demand and supply of cancer care in the country. In addition, the HIRA data did not include the stage of cancer, and survival analysis could not be performed accordingly. Lastly, it was not clear in this study whether the reason patients moved to Seoul for treatment was that there were therapeutic benefits such as a standard level of treatment. In countries like Korea, where all insurance companies are government, and in countries where transportation costs are more problematic than the cost of medical care, national policies are inevitably important, and a consensus is required as a policy.

In conclusion, medical travel to Seoul for upfront breast cancer surgery has been increasing over time. Increasing medical travel poses not only a medical problem but also a social problem. Policies for appropriate healthcare delivery need to be established in the near future.

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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