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Original Article

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Dementia Incidence Rate Before and After Implementing the National Responsibility Policy for Dementia Care in Patients With Vascular Risk Factors in Korea

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ABSTRACT

Background and Purpose: The National Responsibility Policy for Dementia Care was implemented in September 2017 in Korea. This study aimed to compare dementia incidence in Seoul and Gangwon-do before and after the implementation of this policy.
Methods: We extracted insurance claim data from the Korean Health Insurance Review and Assessment Service for people diagnosed with diabetes, hypertension, or dyslipidemia for the first time in Seoul and Gangwon-do, Korea. We defined two enrollment groups based on the policy implementation date: 1) January 1, 2015 to December 31, 2016 (Index 1, pre-implementation), and 2) January 1, 2017 to December 31, 2018 (Index 2, post-implementation). Each group was followed up for 1 year from the time of enrollment. Then, we calculated hazard ratios to compare the incidence of dementia between the two groups, and between Seoul and Gangwon-do.
Results: In Seoul, the incidence of dementia was significantly lower in Index 2 than in Index 1 (hazard ratio [HR], 0.926; 95% confidence interval [CI], 0.875–0.979). However, the incidence rate did not differ between the 2 groups (HR, 1.113; 95% CI, 0.966–1.281) in Gangwon-do. In Index 1, the incidence of dementia did not differ between Seoul and Gangwon-do (HR, 1.043; 95% CI, 0.941–1.156), but in Index 2, was significantly higher in Gangwon-do than in Seoul (HR, 1.240; 95% CI, 1.109–1.386).
Conclusions: After implementing the National Responsibility Policy for Dementia Care, the dementia incidence rate decreased significantly in Seoul, consistent with other studies, but not in Gangwon-do.

Keywords: Dementia; Health Policy; Healthcare Disparities

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Conflict of Interest

The authors have no financial conflicts of interest.

Author Contributions

Conceptualization: Byeon G, Kwon SO, Jhoo JH, Jang JW, Kim Y; Formal analysis: Byeon G, Kwon SO, Jhoo JH; Investigation: Jang JW, Kim Y; Project administration: Byeon G, Kwon SO, Jhoo JH; Writing - original draft: Byeon G, Kwon SO, Jhoo JH; Writing - review & editing: Jang JW, Kim Y.

INTRODUCTION

As the population ages, the prevalence of dementia is increasing, which also increases the social cost burden.[1] In particular, the number of patients with dementia in Korea is rapidly growing compared to that in other countries, coinciding with a rapidly aging population. According to Korea's Central Dementia Center, the number of patients with dementia in Korea is expected to increase from 830,000 to 1 million in 2021 to 2024, and exceed 3 million by 2050.[2] Consequently, the National Responsibility Policy for Dementia Care was implemented in Korea in September 2017. This policy comprises four key elements. First, the government expanded nationwide dementia relief centers to provide services, such as dementia prevention, education, early screening, and care. Second, cognitive function tests are now performed periodically for those aged 66 years and older. If dementia is suspected, the person is connected to a dementia relief center for counseling, testing, and medication cost support. Third, the government lowered the out-of-pocket rate for dementia-related medication and medical expenses. Fourth, the scope of long-term care services was expanded; thus, older adults with mild dementia and good physical function can now use the nurse's home visit service and cognitive rehabilitation program.[3]

The National Responsibility Policy for Dementia Care was first implemented in September 2017 and has been fully operational since the end of 2017, by which time 256 dementia relief centers had been opened: 25 in Seoul, and 18 in Gangwon-do.[4] Therefore, many changes regarding the diagnosis and treatment of dementia have likely occurred; however, a complete assessment of these changes is still lacking. Specifically, the policy's effect on dementia diagnoses before and after implementing the National Responsibility Policy for Dementia Care has not been evaluated.

Moreover, the new national policy might affect certain regions differently. For example, the distribution of medical institutions in Korea differs between urban and rural areas, as does access to medical care.[5] Therefore, it is possible that in the past, obtaining a dementia diagnosis was relatively more straightforward in urban areas than in rural areas, but the implementation of the National Responsibility Policy for Dementia Care may have increased the number of dementia diagnoses in rural areas, compared to urban areas. Furthermore, the National Responsibility Policy for Dementia Care was intended to reduce the overall risk of onset through early treatment and prevention activities and diagnoses. Therefore, the overall incidence may have decreased.

Also, by 2009, dementia support centers in all 25 districts in Seoul had already opened.[6] In this way, the infrastructure was already established in Seoul prior to the implementation of the national dementia responsibility system, and preventive policies related to dementia were implemented. Therefore, it is possible that the impact of the national dementia responsibility system will appear differently in Seoul.

Thus, this study compared the incidence of dementia before and after implementing the National Responsibility Policy for Dementia Care using data from the Korea Health Insurance Review and Assessment Service. In addition, the dementia incidence rates in Seoul (representing urban communities), and Gangwon-do (representing rural communities), were compared before and after the policy was implemented. We hypothesized that the overall incidence of dementia would be lower after implementation of the National Responsibility

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Policy for Dementia Care than before implementation, but that after implementation, the incidence would increase in Gangwon-do, compared to Seoul.

METHODS

Study population

The ethics committee of Kangwon National University Hospital (KNUH-2021-01-003) approved the use of these data. In addition, the Institutional Review Board waived the written informed consent requirement. All methods were performed following the guidelines and regulations of the Kangwon National University Hospital ethics committee.

First, using data provided by the Health Insurance Review and Assessment Service of the Ministry of Health and Welfare in Korea, the diagnosis codes and medications administered during outpatient or hospitalization periods were checked. The diagnosis codes are based on the Korean Standard Classification of Disease (KCD) codes, consistent with the International Classification of Diseases, Tenth Revision (i.e., ICD–10) codes used worldwide.[7] Furthermore, the Health Insurance and Review Assessment (HIRA) in South Korea, also called National Health Insurance Data, is a repository of claims data collected while reimbursing healthcare providers. The universal coverage system has fee-for-services covering all citizens in South Korea; thus, HIRA contains comprehensive and rich information about healthcare services, such as 'treatments,' 'pharmaceuticals,' 'procedures,' and 'diagnoses' for almost 50 million beneficiaries.[8]

HIRA data cannot be fully analyzed; only data of groups defined by specific disease codes or drugs can be extracted. Therefore, we collected data on 858,860 patients over the age of 65 for whom the diabetes (E10–E14), hypertension (I10–I15), and hyperlipidemia (E78) KCD diagnosis codes were recorded for the first time from January 1, 2015 to December 31, 2018, in Seoul and Gangwon-do. Among them, 8,389 patients with past dementia codes (F00–F03, G30, and G31) were excluded, as were two patients whose age was entered as an outlier (999). Finally, 850,469 patients were included in the analysis; 755,931 people lived in Seoul, and 94,538 people lived in Gangwon-do (**Fig. 1**).

Definition of incident dementia

In this study, incident dementia was defined based on previous studies. First, the patient must have documented F00–F03, G30, and G31 KDC codes, typical diagnosis codes for dementia. In addition, a recorded history of dementia medication (donepezil, rivastigmine, galantamine, or memantine) should be present.[9]

Demographic and clinical variables

Age (year) and sex (male or female) based on the entry date were obtained from the HIRA qualification data. In addition, the degree of medical service use was evaluated by calculating the number of uses of various medical and nursing institutions for the past year before enrollment.

Charlson comorbidity index (CCI)

The CCI was used to evaluate each patient's underlying medical history. The CCI verifiably predicts 1-year mortality with scores using existing disease history.[10] We used acute myocardial infarction, congestive heart failure, peripheral vascular disease, cerebral vascular accident, pulmonary disease, connective tissue disease, peptic ulcer, liver disease, diabetes, diabetic complications, paraplegia, renal disease, cancer, metastatic cancer, severe liver

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1. Subjects over 65 years of age who were first diagnosed with diabetes, hypertension, and hyperlipidemia in Gangwon-do, Seoul.

	2015	2016	2017	2018	Total
Total	229,350	206,756	215,564	207,190	858,860
Seoul	203,849	184,446	190,313	184,656	763,264
Gangwon-do	25,501	22,310	25,251	22,534	95,596

2. Excluding subjects who have been diagnosed with dementia in the past.

	2015	2016	2017	2018	Total
Total	226,544	204,505	213,818	205,604	850,471
Seoul	201,356	182,471	188,809	183,297	755,933
Gangwon-do	25,188	22,034	25,009	22,307	94,538

3. Excluding subjects whose age was entered as an outlier.

	2015	2016	2017	2018	Total
Total	226,542	204,505	213,818	205,604	850,469
Seoul	201,354	182,471	188,809	183,297	755,931
Gangwon-do	25,188	22,034	25,009	22,307	94,538

Fig. 1. Flow chart of this study.

disease, and human immunodeficiency virus in the past year before enrollment based on the KCD code to calculate weighted CCI scores. Then, the weighted scores were used to generate a combined score. We used the codes and weighted scores for each disease published in previous studies.[11]

Statistical analyses

The group enrolled between January 1, 2015 and December 21, 2016 was designated as Index 1 (before implementation), while the group enrolled between January 1, 2017 and December 31, 2018 was designated as Index 2 (after implementation). Incident dementia was defined as a case that satisfies the operational definition of dementia during the 1-year follow-up period from enrollment. Cox hazard regression analysis regarding Index 1 was performed in Seoul and Gangwon-do, and changes in the dementia incidence rate were assessed by time (Index 1 vs. Index 2) per region. In addition, in Indices 1 and 2, a Cox analysis was performed with Seoul as the reference, and the difference in dementia incidence by region (Seoul vs. Gangwon-do) was assessed. We obtained adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) from the Cox regression analysis after adjusting for age, sex, CCI, and health service use.

In addition, the above analyses were conducted in subgroups that included patients under and over 75 years of age, to identify differences in the incidence of dementia among younger and elderly older adults. Finally, subgroup analyses were performed in men and women to check for differences between the sexes regarding the incidence of dementia.

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Table 1. General characteristics of participants

Characteristics	Seoul			Gangwon-do		
	Index 1* (n=383,825)	Index 2† (n=372,106)	*p*	Index 1* (n=47,222)	Index 2† (n=47,316)	*p*
Age (yr)	70.5±6.4	69.5±6.2	<0.0001	71.2±7.0	69.5±6.5	<0.0001
<75	291,535 (76.0)	297,614 (80.0)	<0.0001	33,691 (71.4)	37,455 (79.2)	<0.0001
≥75	92,290 (24.0)	74,492 (20.0)		13,531 (28.6)	9,861 (20.8)	
Sex						<0.0001
Male	172,838 (45.0)	171,837 (46.2)	<0.0001	20,846 (44.1)	22,108 (46.7)	
Female	210,987 (55.0)	200,269 (53.8)		26,376 (55.9)	25,208 (53.3)	
CCI	0.81±1.14	0.85±1.17	<0.0001	0.78±1.08	0.82±1.09	<0.0001
0–1	309,909 (80.7)	297,402 (79.9)	<0.0001	39,212 (83.0)	38,693 (81.8)	<0.0001
≥2	73,916 (19.3)	74,704 (20.1)		8,010 (17.0)	8,623 (18.2)	
Diabetes	98,416 (25.6)	97,265 (26.1)	<0.0001	11,830 (25.1)	12,774 (27.0)	<0.0001
Hypertension	202,218 (52.7)	191,203 (51.4)	<0.0001	29,343 (62.1)	29,762 (62.9)	0.0155
Dyslipidemia	139,623 (36.4)	148,868 (40.0)	<0.0001	13,632 (28.9)	14,900 (31.5)	<0.0001
Medical service use	1.66±3.68	1.42±2.37	<0.0001	1.68±3.11	1.36±1.76	<0.0001
1	303,721 (79.1)	307,635 (82.7)	<0.0001	38,165 (80.8)	40,680 (86.0)	<0.0001
≥2	80,104 (20.9)	64,471 (17.3)		9,057 (19.2)	6,636 (14.0)	

Values are presented as mean ± standard deviation or number (%).
CCI: Charlson comorbidity index.
*Index 1: The group enrolled between January 1, 2015 and December 21, 2016; †Index 2: The group enrolled between January 1, 2017 and December 31, 2018.

RESULTS

Table 1 presents the patients' age, sex, CCI, diabetes, hypertension, dyslipidemia, and medical service use. In Seoul and Gangwon-do, the patients in Index 2 were younger than those in Index 1, and there were more men. The CCI score and the prevalence of diabetes, hypertension, and dyslipidemia were higher in Index 2 than in Index 1. However, the number of medical services used was higher in Index 1 than in Index 2 (**Table 1**).

During the 1-year follow-up period, dementia occurred in 7.3 and 5.8 cases per 1,000 people per year in Indices 1 and 2 in Seoul, respectively. In Gangwon-do, 9.0 and 7.7 cases per 1,000 people per year had incident dementia in Indices 1 and 2, respectively (**Table 2**). In addition, the incidence of dementia was higher among those aged 75 years or older than those younger than 75 years in Seoul and Gangwon-do in both indices (**Table 3**). Finally, women had more incident dementia than men in Seoul and Gangwon-do in both indices (**Table 4**).

Table 2. Adjusted HR of dementia incidence according to region and period

Variables	Case/At risk	Person year per 1,000	Adjusted HR (95% CI)	*p*
Seoul				0.0072
Index 1*	2,799/383,825	7.3	1.000 (reference)	
Index 2†	2,161/372,106	5.8	0.926 (0.875–0.979)	
Gangwon-do				0.382
Index 1*	422/47,222	9	1.000 (reference)	
Index 2†	362/47,316	7.7	1.113 (0.966–1.281)	
Index 1*				0.4192
Seoul	2,799/383,825	7.3	1.000 (reference)	
Gangwon-do	422/47,222	9	1.043 (0.941–1.156)	
Index 2†				0.0002
Seoul	2,161/372,106	5.8	1.000 (reference)	
Gangwon-do	362/47,316	7.7	1.240 (1.109–1.386)	

Adjusted by age, sex, Charlson comorbidity index, health service.
HR: hazard ratio, CI: confidence interval.
*Index 1: The group enrolled between January 1, 2015 and December 21, 2016; †Index 2: The group enrolled between January 1, 2017 and December 31, 2018.

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Table 3. Subgroup analysis according to age

Subgroup	Case/At risk	Person year per 1,000	Adjusted HR (95% CI)	*p*
<75				
Seoul				0.0013
Index 1*	809/291,535	2.8	1.000 (reference)	
Index 2†	601/297,614	2	0.840 (0.755–0.934)	
Gangwon-do				0.9839
Index 1*	105/33,691	3.1	1.000 (reference)	
Index 2†	97/37,455	2.6	1.003 (0.757–1.328)	
Index 1*				0.2044
Seoul	809/291,535	2.8	1.000 (reference)	
Gangwon-do	105/33,691	3.1	1.141 (0.931–1.398)	
Index 2†				0.0018
Seoul	601/297,614	2	1.000 (reference)	
Gangwon-do	97/37,455	2.6	1.407 (1.135–1.745)	
≥75				
Seoul				0.6749
Index 1*	1,990/92,290	21.9	1.000 (reference)	
Index 2†	1,560/74,492	21.2	0.986 (0.923–1.054)	
Gangwon-do				0.0471
Index 1*	317/13,531	23.8	1.000 (reference)	
Index 2†	265/9,861	27.3	1.180 (1.002–1.389)	
Index 1*				0.6323
Seoul	1,990/92,290	21.9	1.000 (reference)	
Gangwon-do	317/13,531	23.8	1.029 (0.914–1.159)	
Index 2†				0.0033
Seoul	1,560/74,492	21.2	1.000 (reference)	
Gangwon-do	265/9,861	27.3	1.216 (1.067–1.385)	

Adjusted by age, sex, Charlson comorbidity index, health service.
HR: hazard ratio, CI: confidence interval.
*Index 1: The group enrolled between January 1, 2015 and December 21, 2016; †Index 2: The group enrolled between January 1, 2017 and December 31, 2018.

After adjusting for the various factors, the incidence rate significantly decreased in Index 2 compared to Index 1 in Seoul (HR, 0.926; 95% CI, 0.875–0.979), but no change was observed in Gangwon-do (HR, 1.113; 95% CI, 0.966–1.281). Furthermore, in Index 1, the incidence of dementia did not differ between Seoul and Gangwon-do (HR, 1.043; 95% CI, 0.941–1.156), but in Index 2, the incidence was significantly higher in Gangwon-do than in Seoul (HR, 1.240; 95% CI, 1.109–1.386; **Table 2**).

Among those over 75 years age, the incidence rate did not differ between Index 1 and Index 2 in Seoul (HR, 0.986; 95% CI, 0.923–1.054). However, in Gangwon-do, the incidence rate was significantly higher in Index 2 than in Index 1 (HR, 1.180; 95% CI, 1.102–1.389). Furthermore, in Index 1, the incidence rate did not differ between Seoul and Gangwon-do (HR, 1.029; 95% CI, 0.914–1.159), but in Index 2, the incidence rate was significantly higher in Gangwon-do than in Seoul (HR, 1.216; 95% CI, 1.067–1.385).

For those under 75 years age, the incidence rate was significantly lower in Index 2 than in Index 1 in Seoul (HR, 0.840; 95% CI, 0.755–0.934). However, in Gangwon-do, the incidence rates did not differ between Indices 1 and 2 (HR, 1.003; 95% CI, 0.757–1.328). Finally, in Index 1, the incidence rate did not differ between Seoul and Gangwon-do (HR, 1.141; 95% CI, 0.931–1.398), but in Index 2, the incidence rate was significantly higher in Gangwon-do than in Seoul (HR, 1.407; 95% CI, 1.135–1.745; **Table 3**).

Additionally, the incidence rate in Indices 1 and 2 did not differ between men in Seoul (HR, 0.948; 95% CI, 0.858–1.048), or in Gangwon-do (HR, 1.238; 95% CI, 0.958–1.598).

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Table 4. Subgroup analysis according to sex

Subgroup	Case/At risk	Person year per 1,000	Adjusted HR (95% CI)	*p*
Male				
Seoul				0.2978
Index 1*	852/172,838	4.9	1.000 (reference)	
Index 2†	711/171,837	4.1	0.948 (0.858–1.048)	
Gangwon-do				0.1021
Index 1*	117/20,846	5.6	1.000 (reference)	
Index 2†	122/22,108	5.5	1.238 (0.958–1.598)	
Index 1*				0.7179
Seoul	852/172,838	4.9	1.000 (reference)	
Gangwon-do	117/20,846	5.6	1.036 (0.854–1.258)	
Index 2†				0.00132
Seoul	711/171,837	4.1	1.000 (reference)	
Gangwon-do	122/22,108	5.5	1.370 (1.130–1.660)	
Female				
Seoul				0.0115
Index 1*	1,947/210,987	9.3	1.000 (reference)	
Index 2†	1,450/200,269	7.3	0.916 (0.856–0.980)	
Gangwon-do				0.5344
Index 1*	305/26,376	11.6	1.000 (reference)	
Index 2†	240/25,208	9.6	1.055 (0.891–1.251)	
Index 1*				0.4667
Seoul	1,947/210,987	9.3	1.000 (reference)	
Gangwon-do	305/26,376	11.6	1.046 (0.927–1.181)	
Index 2†				0.0181
Seoul	1,450/200,269	7.3	1.000 (reference)	
Gangwon-do	240/25,208	9.6	1.179 (1.029-–1.352)	

Adjusted by age, sex, Charlson comorbidity index, health service.
HR: hazard ratio, CI: confidence interval.
*Index 1: The group enrolled between January 1, 2015 and December 21, 2016; †Index 2: The group enrolled between January 1, 2017 and December 31, 2018.

Furthermore, among men in Index 1, the incidence rate did not differ between Seoul and Gangwon-do (HR, 1.036; 95% CI, 0.854–1.258). However, for men in Index 2, the incidence rate was significantly higher in Gangwon-do than in Seoul (HR, 1.370; 95% CI, 1.130–1.660).

Finally, in Seoul, the incidence rate was significantly lower for women in Index 2 than in Index 1 (HR, 0.916; 95% CI, 0.856–0.980). However, the incidence rate did not differ between Indices 1 and 2 for women in Gangwon-do (HR, 1.055; 95% CI, 0.891–1.251). Moreover, for women in Index 1, the incidence rate did not differ between Seoul and Gangwon-do (HR, 1.046; 95% CI, 0.927–1.181), but for women in Index 2, the incidence rate was significantly higher in Gangwon-do than in Seoul (HR, 1.179; 95% CI, 1.029–1.352; **Table 4**).

DISCUSSION

In this study, after the National Responsibility Policy for Dementia Care was implemented, the dementia incidence rate significantly decreased in Seoul, but not in Gangwon-do. Furthermore, the crude incidence rate in Seoul was 7.3 cases per 1,000 people per year before implementation (Index 1), comparable to the rates of 5.51 cases in 2014 and 5.21 cases in 2016 for those aged 60 and over in a previous study.[12] Also, before policy implementation, the incidence rate did not differ between Seoul and Gangwon-do. However, after policy implementation (Index 2), the incidence of dementia was significantly higher in Gangwon-do than in Seoul.

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There was a 2-year time interval between Index 1 and Index 2. However, we adjusted for age, sex, underlying medical diseases, and medical service differences to offset some of the demographic and socioeconomic changes over this period. Excluding these, the most considerable socioeconomic change between the two index groups was the implementation of the National Responsibility Policy for Dementia Care, which likely explains the differences in incidence rates in this study.

We identified a significant decrease in dementia in Seoul over 2 years, consistent with a previous report on the dementia incidence rate in Seoul. Data from the Korea National Health Insurance Service in Seoul from 2003 to 2018 indicated that the dementia incidence rate increased from 2003 (1.60 cases per 1,000 people per year) to 2011 (6.41 cases per 1,000 people per year), but decreased from 2011 to 2018 (4.48 cases per 1,000 people per year).[12] Furthermore, the age-adjusted incidence of dementia is decreasing worldwide, especially in developed countries in the western world, primarily due to managing vascular risk factors, such as hypertension and diabetes.[13] Previous studies have suggested that preventive interventions, such as increasing physical activity, maintaining a healthy weight, and quitting smoking, reduce the risk of dementia.[14,16] Before the National Responsibility Policy for Dementia Care was implemented, the Seoul Metropolitan Government opened the Seoul Metropolitan Dementia Center in 2006, and implemented the dementia prevention policy. Most of the core contents of the current national dementia responsibility system were included in this project, such as dementia prevention, awareness, and early diagnosis, prevention registration management, and strengthening of community resources.[6] For chronic diseases in older people, such as dementia, it is difficult for preventive policies to have an immediate effect in the real world.[17] Therefore, we can infer that the decreased dementia incidence from 2011 to 2018 was due to the implementation of the dementia prevention policy in Seoul in 2006 and the national prevention policy. The prevalence of dementia in developed countries in the West has also decreased with preventative approaches, supporting this hypothesis.[13]

Conversely, in this study, the incidence of dementia in Gangwon-do did not change after policy implementation. A previous study in China suggested that due to low education levels, the prevalence of dementia in rural areas was higher than in urban areas.[18] Furthermore, a previous cohort study conducted in 12-year intervals (1996–2003 and 2008–2015) in a rural area (Yeoncheon-gun) in Korea reported that the dementia incidence decreased by 40%, from (27.2 to 16.2) cases per 1,000 people per year, primarily due to improvements in the residents' education level.[19] We found no difference in the incidence rate before and after the national policy was implemented in Gangwon-do, unlike in Seoul. We suspect these results can be seen as a result of the combination of the relatively insufficient existing medical environment of Gangwon-do, and the implementation of the current national responsibility system for dementia. A previous study reported that a lack of accessibility to services and low referral rates by general practitioners caused decreased mental health literacy in older individuals.[20] Among the metropolitan autonomous regions in Korea, Gangwon-do has the least amount of access to medical institutions,[21] and although it is the largest administrative district in Korea, there are only two high-level general hospitals.[22] In this situation, low mental health literacy might have resulted in an underdiagnosis of dementia in Gangwon-do. The National Responsibility Policy for Dementia Care tried to bring previously neglected patients with undiagnosed dementia into the treatment setting. Notably, in Index 1 (before implementation), we found no difference in the incidence of dementia between Seoul and Gangwon-do, but in Index 2 (after implementation; **Table 2**), the incidence rate was

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significantly higher in Gangwon-do than in Seoul. Therefore, our results imply that until the National Responsibility Policy for Dementia Care was implemented, a significant number of patients in Gangwon-do, despite symptoms of dementia, did not receive an appropriate diagnosis and treatment.

In Index 2, those aged 75 years or older and men had a significantly higher incidence of dementia in Gangwon-do than in Seoul (**Tables 3** and **4**). Previous studies have identified that older individuals and women have a higher risk for dementia.[23] Presumably in Gangwon-do, after the National Responsibility Policy for Dementia Care was implemented, the screening test for dementia was performed more regularly in the older adult population, resulting in a higher incidence of dementia. Additionally, the relative increase in the incidence of dementia in men in Gangwon-do, who have low risk compared to women, is likely because in Korea, men generally use the medical system relatively less than women.[24] Thus, these previously undiagnosed men in Gangwon-do received a diagnosis after the National Responsibility Policy for Dementia Care was implemented, which encouraged screening and preventative care.

A major limitation of this study is that the diagnosis of dementia was defined operationally based on the use of anti-dementia medication in the diagnostic code of the HIRA database. According to Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, to diagnose dementia, there should be cognitive decline reported by the patient, caregiver, or clinician, and this should be proven through an objective neuropsychological test.[25] The operational definition of this study did not consider clinical evaluation and neuropsychological testing. However, as a realistic method to utilize large-scale clinical field data, an operational definition was inevitable; and for the same reason, an operational definition of dementia using diagnosis codes and drug codes was used in previous studies.[26,27]

A further limitation of this study is that it cannot guarantee the representativeness of the entire elderly population, because the study subjects were limited to those diagnosed with diabetes, hypertension, and hyperlipidemia for the first time. However, a 2020 survey of those over 65 in Korea showed that the incidences of hypertension, dyslipidemia, and diabetes were (56.8%, 17.1%, and 24.2%), respectively.[28] Therefore, a majority of the elderly population in Korea have at least one of these three diseases. In addition, hypertension, diabetes, and dyslipidemia are known risk factors for the onset of dementia[29,30]; thus, it is meaningful in terms of health policy to see the progression of dementia in those diagnosed with these underlying diseases.

A third limitation is that this population is likely relatively healthy, considering these patients were first diagnosed with these diseases (hypertension, diabetes, and dyslipidemia) at age 65 years or older. However, even though we selected patients based on those with first-time entered diagnostic codes for hypertension, diabetes, and dyslipidemia (i.e., the first documented administration of treatment and medications), the period of suffering from these underlying chronic diseases was likely longer. Among Koreans, drug administration rates among patients with hypertension and diabetes are (65.5% and 63.5%), respectively, supporting this theory.[31] Thus, considering the high prevalence of the abovementioned diseases and the low treatment rate, it is highly likely that the enrolled group is not as healthy as initially anticipated. In addition, this study compared the incidence rates of the target groups under the same conditions based on time and region. Therefore, we expect that the influence of this bias on the study results is relatively minimal. Finally, patients that visit the hospital for the first time due to chronic disease are highly likely to use medical services less

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often. Therefore, in these groups, the increased incidence or detection of dementia after implementing the national policy might be the effect of comprehensive dementia screening.

A final limitation is that the follow-up period for the enrolled subjects was short (1 year). However, this study was intended to compare the relatively short period before and after the national policy was implemented. Thus, designing a long-term follow-up was difficult. In addition, this study did not intend to look at the progression from normal cognition to dementia, but rather to see the change in discovering patients with undiagnosed dementia in the community. Hence, a short observation period was considered fit for the study's purpose.

In conclusion, after the National Responsibility Policy for Dementia Care was implemented, the incidence of dementia in the population with vascular risk factors in Seoul significantly decreased, but in Gangwon-do, the incidence rate did not decrease. Part of this trend may be due to the influence of early screening, which was especially increased in Gangwon-do, and preventive intervention, which has been implemented for a longer time in Seoul. However, due to the limitations of this study, it cannot be ruled out that various other factors may have contributed to these changes. Therefore, it seems that a follow-up study that is more systematic, and corrects for various variables, should be conducted.

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