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Impact of Comprehensive Primary Care in Patients With Complex Chronic Diseases: Nationwide Cohort Database Analysis in Korea

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ABSTRACT

Background: More comprehensive healthcare services should be provided to patients with complex chronic diseases to better manage their complex care needs. This study examined the effectiveness of comprehensive primary care in patients with complex chronic diseases.
Methods: We obtained 2002–2019 data from the National Health Insurance Sample Cohort Database. Participants were individuals aged ≥ 30 years with at least two of the following diseases: hypertension, diabetes mellitus, and hyperlipidemia. Doctors' offices were classified into specialized, functional, and gray-zone based on patient composition and major diagnostic categories. The Cox proportional hazard model was used to examine the association between office type and hospital admission due to all-causes, severe cardiovascular or cerebrovascular diseases (CVDs), hypertension, diabetes mellitus, or hyperlipidemia.
Results: The mean patient age was 60.3 years; 55.8% were females. Among the 24,906 patients, 12.8%, 38.3%, and 49.0% visited specialized, functional, and gray-zone offices, respectively. Patients visiting functional offices had a lower risk of all-cause admission (hazard ratio [HR], 0.935; 95% confidence interval [CI], 0.895–0.976) and CVD-related admission (HR, 0.908; 95% CI, 0.844–0.977) than those visiting specialized offices. However, the admission risks for hypertension, diabetes mellitus, and hyperlipidemia were not significantly different among office types.
Conclusion: This study provides evidence of the effectiveness of primary care in functional doctors' offices for patients with complex chronic diseases beyond a single chronic disease and suggests the need for policies to strengthen functional offices providing comprehensive care.

Keywords: Primary Care; Comprehensiveness; Hospital Admission; Retrospective Cohort Study; National Health Insurance Sampled Cohort Database

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Author Contributions
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INTRODUCTION

Primary care plays a crucial role in health care services in communities. As the incidence of complex chronic diseases—conditions involving multiple chronic diseases—increases because of the aging population, strengthening primary care is required to respond to health needs.[1] Moreover, more comprehensive healthcare services must be provided to patients with complex chronic diseases.[2]

Since the theoretical definition of primary care was published by the Institution of Medicine and The Alma-Ata Declaration of 1978,[3] different definitions have emerged.[4] Nevertheless, the elements of first contact, continuity, comprehensiveness, and coordination are included in most definitions.[5] Countries generally define primary care by reflecting their systems according to department and doctors' licenses. The United Kingdom classifies general practitioners as primary care providers, while the United States (US) and Germany classify doctors of internal medicine, pediatrics, and family medicine as primary care providers.[6] Several studies have reported on the definition of primary care in Korea.[6-9] A study used a Delphi method to define the concept of the four primary selected core attributes (first-contact care, comprehensiveness, coordination, and longitudinality) and three ancillary (personalized care, family and community context, and community base) attributes.[9] However, the function of primary care in South Korea is not clearly defined. Studies have attempted to define the function of primary care based on diagnostic distribution.[6,10-12] A recent study based on a data analysis classified doctors' offices into specialized, functional, and gray-zone types by focusing on comprehensiveness, a core element of primary care.[6,12] However, to the best of our knowledge, no studies have reported an association between these functional classifications and patients' health outcomes.

Continuity of care and comprehensiveness are considered the core values of primary care, especially for patients with complex chronic diseases.[13,14] Previous studies reported an association between continuity of care and health outcomes in patients with chronic diseases. These studies concluded that continuity of care reduced the risk of emergency visits and avoidable hospital admission[4,15-17] and led to reduced medical costs [18-20] With regards to comprehensiveness, in a US study of Medicare Part A and B claims, comprehensiveness of care was associated with decreasing costs and hospital admission rates. However, the association between primary care comprehensiveness and better health outcomes requires further explanation. Here we examined the association between comprehensiveness and hospital admissions, indicators that are commonly used to measure the effectiveness of primary care in patients with complex chronic diseases.

METHODS

Study design and data source

This retrospective cohort study examined data from the National Health Insurance (NHI) Sample Cohort Database of the National Health Insurance Service. This database includes a cohort of healthcare usage data spanning from 2002 to 2019 (18 years) for qualified individuals as of 2006, targeting approximately 1 million patients. The sampling method used a 2% stratified extraction from the total national population classified by sex, age, insurance type, insurance premium payment quintile, and region.

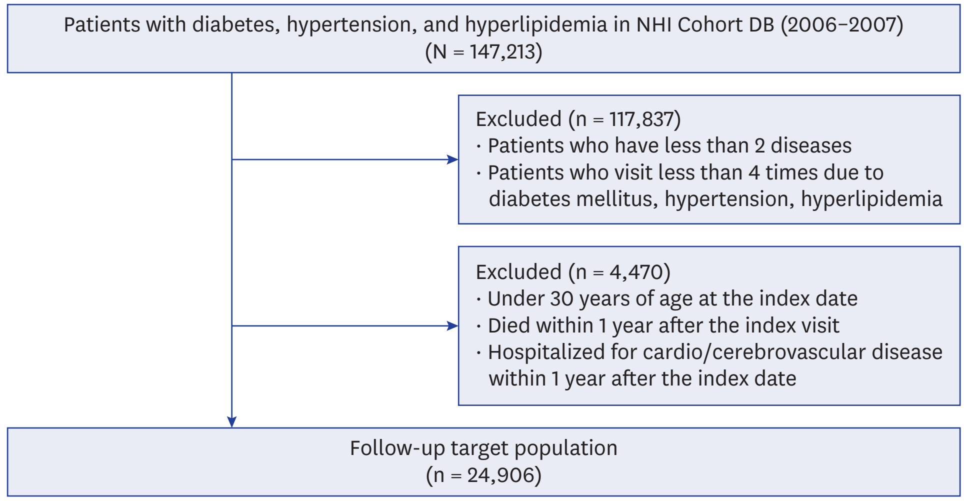

Fig. 1. Flow chart of study population.
NHI = National Health Insurance, DB = database.

Study population

The study participants were individuals aged ≥ 30 years with complex chronic conditions, specifically those who have at least two of the following diseases: hypertension (International Classification of Disease, 10th Revision [ICD-10]: I10.x–I13.x), diabetes (ICD-10: E10.x–E14.x), and hyperlipidemia (E78.x) (**Fig. 1**). Patients who received outpatient care for these conditions in 2006–2007 were included, and their first visit during this period was set as the index date. Patients who visited more than four times within a year of the index date were selected to improve patient selection sensitivity. In this process, patients < 30 years of age, those who died within 1 year of the index date, and those already exposed to outcome indicators, such as hospital admissions due to severe cardiovascular and cerebrovascular diseases (CVDs), during the follow-up period were excluded to minimize selection bias. Finally, 24,906 individuals were selected as follow-up targets (**Fig. 1**).

Outcome measures and variables

The outcomes of interest were hospital admission rates for all-cause, severe CVD (ICD-10: I20–I25, I60–I64) and hypertension/diabetes mellitus/hyperlipidemia. The primary diagnosis was screened to identify hospital admissions, and patients were followed up until December 31, 2019.

The independent variable was office functional classification, which reflects comprehensiveness. This classification included all medical records of outpatient care from 3 years (2006–2008), and the criteria suggested in a previous study[6] were applied. Of the 25 major diagnostic category (MDC) codes, 10 considered essential were selected from all medical records (**Table 1**). The number of MDC codes and total number of records were calculated for each office. If at least one code accounted for 60% or more of the total number of records, the office was classified as specialized. Offices that were not classified as specialized but recorded all 10 MDC codes were classified as functional. Those that did not fall into either of those categories were classified as gray-zone. The early management of chronic diseases is crucial and can significantly impact patients' future health outcomes; therefore, we determined the types of offices that the patients visited most frequently in the initial 2 years based on the index date and analyzed their hospital admissions.

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Table 1. Ten essential MDC for classification of functional doctor's office

MDC number and definition		ICD-10
MDC 1	Diseases and disorders of the nervous system	G00–G99
MDC 3	Ear, nose, mouth, and throat diseases and disorders	H00–H99
MDC 4	Respiratory system diseases and disorders	J00–J99
MDC 5	Circulatory system diseases and disorders	I00–I99
MDC 6	Diseases and disorders of the digestive system	K00–K99
MDC 8	Diseases and disorders of the musculoskeletal system and connective tissue	M00–M99
MDC 9	Diseases and disorders of the skin, subcutaneous tissue and breasts	L00–L99
MDC 10	Endocrine and nutritional metabolic diseases and disorders	E00–E99
MDC 11	Diseases and disorders of the kidneys and urinary system	N00–N99
MDC 19	Mental illness and disability	F00–F99

MDC = major diagnostic category, ICD-10 = International Classification of Diseases, 10th Revision.

Age (categorized as 30–39, 40–49, 50–59, 60–69, and ≥ 70 years), sex, income, and Charlson Comorbidity Index (CCI) were included as potential covariates. Income was classified into six groups (Medicaid and classes 1–5 based on health insurance premiums). CCI was measured by screening health service utilization for the previous year based on the index date, and the participants were divided into four groups (0, 1, 2, ≥ 3). The CCI is frequently used to reflect patient severity in outcome studies of health insurance data. The CCI, which consists of 17 diseases, was calculated for 15 here (excluding hypertension and diabetes, the subjects of this study).[21]

Statistical analysis

The patients' general characteristics are presented as descriptive statistics, including frequency and percentage for continuous variables and mean and standard deviation for categorical variables. Comparisons between patient characteristics and office functional classification were performed using the χ^2 test or analysis of variance. Hospital admission rates per 100,000 patient-years were defined as the number of hospital admissions divided by the number of patient-years multiplied by 100,000. Cox's proportional hazard model was used to explore the association between hospital admission and office functional classification after the adjustment for age, sex, income, CCI, estimated adjusted hazard ratio (HR), and 95% confidence interval (CI). The proportional hazards assumption was checked using log-log plots. All statistical analyses were performed using the SAS Enterprise Guide 7.1. (SAS Institute Inc., Cary, NC, USA), and values of $P < 0.05$ were considered statistically significant.

Ethics statement

This study was reviewed and approved by the Institutional Review Board of Korea University (approval No. KUIRB-2022-0346-01). No informed consent was required from patients due to the nature of public data from National Health Insurance Service.

RESULTS

Participants' general characteristics

The population characteristics of this study showed a distribution of 24,906 patients across specialized, functional, and gray zone doctors' offices (**Table 2**). In terms of disease groups, 37.4% had both hypertension and diabetes, 34.8% had hypertension and hyperlipidemia, 11.2% had diabetes mellitus and hyperlipidemia, and 16.6% had all three conditions, with significant differences in the distribution of these groups across office types ($P < 0.001$). The mean patient age was 60.3 years (standard deviation, 11.2 years). The age distribution

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Table 2. Patients' general characteristics

Characteristics	Total	Doctor's office classification			*P* value
		Specialized	Functional	Gray-zone	
Total	24,906 (100.0)	3,182 (12.8)	9,532 (38.3)	12,192 (49.0)	-
Disease group					< 0.001
HT+DM	9,304 (37.4)	1,352 (42.5)	3,551 (37.3)	4,401 (36.1)	
HT+HL	8,663 (34.8)	959 (30.1)	3,286 (34.5)	4,418 (36.2)	
DM+HL	2,797 (11.2)	371 (11.7)	1,087 (11.4)	1,339 (11.0)	
HT+DM+HL	4,142 (16.6)	500 (15.7)	1,608 (16.9)	2,034 (16.7)	
Age, yr					
Mean ± SD	60.3 ± 11.2	61.1 ± 11.4	60.2 ± 11.2	60.2 ± 11.2	< 0.001
30–39	824 (3.3)	105 (3.3)	320 (3.4)	399 (3.3)	0.001
40–49	3,752 (15.1)	424 (13.3)	1,489 (15.6)	1,839 (15.1)	
50–59	7,046 (28.3)	845 (26.6)	2,650 (27.8)	3,551 (29.1)	
60–69	7,744 (31.1)	1,013 (31.8)	2,967 (31.1)	3,764 (30.9)	
≥ 70	5,540 (22.2)	795 (25.0)	2,106 (22.1)	2,639 (21.7)	
Sex					0.010
Male	10,996 (44.2)	1,362 (42.8)	4,134 (43.4)	5,500 (45.1)	
Female	13,910 (55.8)	1,820 (57.2)	5,398 (56.6)	6,692 (54.9)	
Income group					0.016
Medicaid	1,836 (7.4)	245 (7.7)	735 (7.7)	856 (7.0)	
Class 1	3,759 (15.1)	419 (13.2)	1,440 (15.1)	1,900 (15.6)	
Class 2	3,391 (13.6)	412 (13.0)	1,315 (13.8)	1,664 (13.7)	
Class 3	3,611 (14.5)	472 (14.8)	1,370 (14.4)	1,769 (14.5)	
Class 4	5,353 (21.5)	676 (21.2)	2,056 (21.6)	2,621 (21.5)	
Class 5	6,956 (27.9)	958 (30.1)	2,616 (27.4)	3,382 (27.7)	
CCI					0.020
0	8,331 (33.4)	1,092 (34.3)	3,103 (32.6)	4,136 (33.9)	
1	8,561 (34.4)	1,037 (32.6)	3,293 (34.6)	4,231 (34.7)	
2	5,006 (20.1)	643 (20.2)	1,937 (20.3)	2,426 (19.9)	
≥ 3	3,008 (12.1)	410 (12.9)	1,199 (12.6)	1,399 (11.5)	

Values are shown as number (%), column % for total; row % for doctor's office classification.
HT = hypertension, DM = diabetes mellitus, HL = hyperlipidemia, SD = standard deviation, CCI = Charlson Comorbidity Index.

varied, with the smallest group being those aged 30–39 years (3.3%) and the largest being those aged 60–69 years (31.1%). Of the patients, 55.8% were female, and the distribution of sex and age differed significantly among the office types. Income groups ranged from Medicaid recipients to higher-income classes, with disparities in doctor office visits noted across categories ($P = 0.016$). Finally, the CCI, which ranged from 0 to ≥ 3, indicated varying comorbidity levels among the patients, with significant differences in their distribution across office types ($P = 0.020$).

Association between hospital admission rate and office type

Hospital admission rates per 100,000 patient-years according to office type are shown in **Table 3**. The all-cause admission rate per 100,000 patient-years was 15,725.7, while the severe CVD and hypertension/diabetes mellitus/hyperlipidemia admission rates per 100,000 patient-years were 2,853.2 and 1,347.2, respectively. Specialized offices had higher hospital

Table 3. Hospital admission rate per 100,000 patient-years by doctor's office classification

Characteristics	Total			Specialized			Functional			Gray-zone		
	No. of admissions	Time at risk for hospital admission	Admission per 100,000 patient-years	No. of admissions	Time at risk for hospital admission	Admission per 100,000 patient-years	No. of admissions	Time at risk for hospital admission	Admission per 100,000 patient-years	No. of admissions	Time at risk for hospital admission	Admission per 100,000 patient-years
All-cause	21,033	133,749.1	15,725.7	2,736	16,014.8	17,084.3	8,027	51,555.5	15,569.6	10,270	66,178.8	15,518.6
CVD	7,025	246,210.6	2,853.2	998	30,321.4	3,291.4	2,671	94,449.9	2,828.0	3,356	121,439.3	2,763.5
HT or DM or HL	3,579	265,667.8	1,347.2	514	33,245.2	1,546.1	1,393	101,600.7	1,371.1	1,672	130,822.0	1,278.1

CVD = cardiovascular or cerebrovascular disease, HT = hypertension, DM = diabetes mellitus, HL = hyperlipidemia.

admission rates than the other office types, which were similar to each other. The all-cause admission rate per 100,000 patient-years in a specialized office was 17,084.3. The severe CVD admission rate per 100,000 patient-years was 3,291.4 in specialized offices, followed by 2,828.0 in functional offices and 2,763.5 in gray-zone offices. The hypertension/diabetes mellitus/hyperlipidemia admission rates per 100,000 patient-years of specialized and functional offices were 1,546.1 and 1,371.1, respectively.

According to the Cox proportional hazards model (**Table 4**), the HR indicated that patients visiting functional offices had a lower risk of all-cause admission (HR, 0.935; 95% CI, 0.895–0.976) and severe CVD admission (HR, 0.908; 95% CI, 0.844–0.977) than those visiting specialized offices. Similarly, patients visiting gray-zone offices had a reduced risk of all-cause admission (HR, 0.945; 95% CI, 0.906–0.985) and severe CVD admission (HR, 0.904; 95% CI, 0.843–0.971). However, the admission risks for hypertension, diabetes mellitus, and hyperlipidemia were not significantly different among office types. Age was a significant factor, with increasing age groups showing a higher risk of admission across all categories, with those aged ≥ 70 years having more than twice the risk of the 30–39 years age group. Patients with hypertension and hyperlipidemia were at significantly lower risk of all-cause admission (HR, 0.789; 95% CI, 0.764–0.816) and the lowest risk of admission due to hypertension, diabetes mellitus, or hyperlipidemia (HR, 0.261; 95% CI, 0.236–0.288).

Table 4. Cox proportional hazard model of association between doctor's office classification and hospital admission

Characteristics	All-cause admission	Severe CVD admission	Admission due to HT or DM or HL
Doctor's office classification			
Specialized	1.000	1.000	1.000
Functional	0.935 (0.895–0.976)	0.908 (0.844–0.977)	0.954 (0.862–1.055)
Gray-zone	0.945 (0.906–0.985)	0.904 (0.843–0.971)	0.913 (0.826–1.008)
Age, yr			
30–39	1.000	1.000	1.000
40–49	1.130 (1.030–1.239)	1.183 (0.983–1.424)	0.943 (0.747–1.191)
50–59	1.426 (1.305–1.559)	1.504 (1.259–1.797)	1.066 (0.853–1.331)
60–69	1.934 (1.769–2.113)	2.128 (1.784–2.538)	1.315 (1.054–1.640)
≥ 70	2.504 (2.286–2.742)	2.911 (2.434–3.481)	1.883 (1.505–2.356)
Sex			
Male	1.000	1.000	1.000
Female	1.070 (1.040–1.101)	0.817 (0.778–0.858)	1.040 (0.970–1.116)
Disease group			
HT+DM	1.000	1.000	1.000
HT+HL	0.789 (0.764–0.816)	0.471 (0.443–0.501)	0.261 (0.236–0.288)
DM+HL	0.924 (0.881–0.968)	0.828 (0.764–0.897)	0.858 (0.773–0.953)
HT+DM+HL	0.960 (0.923–0.999)	0.932 (0.875–0.993)	0.897 (0.824–0.977)
Income group			
Medicaid	1.000	1.000	1.000
Class 1	0.836 (0.787–0.888)	0.709 (0.643–0.781)	0.601 (0.528–0.684)
Class 2	0.851 (0.799–0.905)	0.702 (0.634–0.776)	0.619 (0.542–0.706)
Class 3	0.843 (0.793–0.897)	0.703 (0.637–0.777)	0.616 (0.540–0.701)
Class 4	0.865 (0.817–0.917)	0.672 (0.613–0.738)	0.575 (0.509–0.650)
Class 5	0.848 (0.802–0.897)	0.691 (0.633–0.755)	0.537 (0.478–0.604)
Charlson Comorbidity Index			
0	1.000	1.000	1.000
1	1.125 (1.088–1.163)	1.076 (1.015–1.141)	1.063 (0.979–1.153)
2	1.228 (1.182–1.276)	1.165 (1.089–1.245)	1.104 (1.005–1.213)
≥ 3	1.462 (1.397–1.529)	1.391 (1.291–1.499)	1.327 (1.195–1.473)

Values are presented as hazard ratio (95% confidence interval).
CVD = cardiovascular or cardiovascular disease, HT = hypertension, DM = diabetes mellitus, HL = hyperlipidemia.

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DISCUSSION

The comprehensiveness of primary care is a core element, particularly for individuals with complex chronic diseases. Using data from a nationally representative database, we examined the association between hospital admission and comprehensiveness in patients with complex chronic diseases, including hypertension, diabetes mellitus, and hyperlipidemia. Patients who visited a functional office for comprehensive care had significantly decreased hospital admission rates due to all-cause diseases and severe CVD than those treated in specialized offices, although no difference was observed in the admission risk of hypertension/diabetes mellitus/hyperlipidemia among the office types.

This study classified doctors' offices into functional, specialized, and gray-zone types according to the functional classification of primary care presented in a previous study.[6] Of the 24,906 patients, 49.0% and 38.3% received outpatient care for complex chronic diseases at gray-zone and functional clinics, respectively. These proportions were similar to those reported in the previous study. However, the proportions differed among these groups, possibly due to how the offices were defined. In this study, first, each office recording at least 1 of 10 MDC, accounting for 60% of all medical records, was classified as a specialized office. Second, an office for which all 10 MDC were recorded at least once was defined as a functional office. And third, the remaining offices were classified as gray-zone offices; as a result, approximately half with different characteristics within the classification were included in the gray-zone office classification. Therefore, our results must be interpreted carefully considering the classification criteria.

An analysis of the association between hospital admission and comprehensiveness revealed that patients visiting functional offices were at significantly lower risk of all-cause and severe CVD admissions than those visiting specialized offices. However, the admission risks for hypertension, diabetes mellitus, and hyperlipidemia did not differ significantly among office types. These results indicate no difference in clinical practice for hypertension, diabetes mellitus, and hyperlipidemia among the functional classifications of offices and that comprehensive care is needed to prevent hospital admissions due to related diseases. These findings are consistent with those of previous studies, although a direct comparison with other studies is limited because of the different definitions of the study subjects. In a Korean study of Korea Health Panel data, the use of a primary care physician was associated with a decreased incidence of emergency department visits (odds ratio, 0.61; 95% CI, 0.40–0.93) and hospital admission (odds ratio, 0.69, 95% CI, 0.49–0.96), compared to those lacking a primary care physician.[22] In a US study of Medicare fee-for-service claims, receiving comprehensive primary care was associated with 8.84 fewer hospital admissions per 1,000 beneficiaries per year,[23] and Henry et al.[24] reported a negative association between comprehensiveness and hospital admission. However, Bazemore et al.[25] reported a negative association between comprehensiveness and Medicare payments but no significant association between comprehensiveness and hospital admission rates.[25]

Although this was the first study to investigate the association between functional doctor's office classification and hospital admission, it had some limitations. First, we applied an operational definition that included patients with complex chronic diseases, especially those who visited the doctor's office more than four times a year for diseases including hypertension, diabetes mellitus, and hyperlipidemia. However, because patients with chronic diseases continuously receive care, patients with early-stage diseases might have been excluded. Second, the hospital admission rates due to severe CVD and chronic diseases may have been underestimated because this study used only primary diagnoses. Third, factors that may also affect hospital admission, such as clinical laboratory test results and family history, were not considered potential covariates. This information reflective of disease severity was not available in the NHI Sample Cohort Database, which was constructed for reimbursement purposes. Patients with all three diseases—hypertension, diabetes mellitus, and hyperlipidemia—had a lower risk of hospital admission than a reference group, patient with hypertension and diabetes mellitus. In this study, CCI was used to adjust for disease severity, but it is possible that the result was caused by the fact that disease severity was not completely adjusted for. Finally, this study classified doctors' offices using the MDC, which has rarely been attempted, and the results were similar to those of a previous study. Further studies are required to assess the validity of the functional classification by considering clinical factors and disease severity.

This is the first study to investigate the association between comprehensive primary care and hospital admissions by analyzing data from a nationally representative database. Patients with complex chronic diseases—hypertension, diabetes mellitus, and hyperlipidemia—who visited a functional doctor's office had lower all-cause and severe CVD hospital admission rates than those who visited a specialized office. This finding underscores the need to strengthen functional offices within the primary care system by focusing on comprehensive disease management. Moreover, it highlights the importance of policies targeting patients who consistently visit functional offices to maintain or improve their health outcomes.

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