Analysis of continuity of care and related factors in diabetic patients in Korea

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Research article

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Abstract

Background: Diabetes is one of the fastest growing diseases with approximately 463 million patients worldwide. It is established that to manage diabetes, continuity of care in primary care setting is crucial. We aim to statistically define and analyze factors of continuity that are associated with patient, clinic, and geographical relationship.

Methods: We used 2014~2015 claim data from National Health Insurance Service (NHIS), with 39,096 eligible outpatient attendances across 29,912 office-based clinics. We applied multivariable logistic regression to analyze factors that may affect three kinds of continuity of care index for each patient: most frequent provider continuity index (MFPC), modified-modified continuity index (MMCI), and continuity of care index (COC).

Results: Mean value of continuity of care indices were MFPC 0.90, MMCI 0.96, COC 0.85. Among patient factors, old age above 80 (MFPC 0.81 [0.74-0.89], MMCI 0.84 [0.76-0.92], COC 0.81 [0.74-0.89]) and disability were strongly associated with lower continuity of care. Another significant factor was residential area: further the patients lived from their primary care clinic, lower the continuity of diabetes care (MFPC 0.74 [0.70–0.78], MMCI 0.70 [0.66–0.73], COC 0.74 [0.70–0.78]). Patients who lived in metropolitan areas had higher continuity of care compared to those of other areas (metropolitan area, MFPC 1.19 [1.17-1.27], MMCI 1.17 [1.10-1.25], COC 1.19 [1.12-1.27]). There was no statistical significance among clinic factors, such as the number of physicians or nurses hired per clinic, between the lower and the higher continuity of care groups.

Conclusion: Geographical proximity of patient's residential area and clinic location showed the strongest correlation as factor of continuity. Political support is necessary to geographically align the imbalance of supply and demand of medical needs.

Background

Diabetes is one of the fastest growing diseases, with approximately 463 million patients worldwide[1]. The majority of these patients suffer from type 2 diabetes, which is the leading cause of death globally. According to the International Diabetes Federation, 10% of all global health expenditure is spent on diabetes, causing an immense public concern. In 2019, American Diabetes Association emphasized continuity of care for managing diabetes and its comorbidities [2].

Studies on interpersonal continuity of diabetic patients revealed that higher continuity of care improved patient satisfaction, consequently lowering both HbA1c level and cost of care [3 4]. Furthermore, multiple RCTs, systematic reviews, and observational studies showed that higher continuity in diabetic patients was associated with fewer ER visits and lower mortality rates, which are some of the medical goals of diabetes care [2 5 6].

As continuity of care received increasing attention [7 8], numerous studies attempted to evaluate the factors of continuity to apply to primary healthcare environment. However, there have only been observational studies to examine the continuity of care, each with several limitations. Researches carried out in Europe categorized and determined factors associated with the level of continuity as population demographic, quality of care[9], and interpersonal relationship – between patient and physician[3]. Yet many of the factors mentioned were investigated based on surveys and interviews, making them susceptible to bias.

Korean healthcare provision is distinctive in that all hospitals and clinics are covered by a single and mandatory public insurance system. Recent observational studies carried out in Korea reported that gender, comorbidity, income, types of medical institution were correlated to continuity of care in diabetes[10 11]. The researches were conducted with clinical data, but lacked variety of analyzed factors.

This study aims to use nationwide health insurance claim data to measure continuity of care, and determine its factors associated with patients, clinics, and geographical relationship. Although the association of continuity and geographical proximity of primary care clinics may seem obvious, it has not been investigated before.

Methods

Data source and study population

This study used claim data from the National Health Insurance Service (NHIS) National Sample Cohort, a population-based cohort. The cohort had been first sampled in 2002 NHIS database and had been followed up until 2017. The NHIS enrolees cover approximately 97% of all Koreans, and with a random sampled rate of 2%, this sample cohort includes 1,000,000 individuals. We used data collected from 2014 to 2015, including 22,275,040 outpatient attendances across 29,912 office-based clinics. From this pool, we selected patients who had attended outpatient clinics for diabetes mellitus based on diagnosis records. The NHIS data contains diagnosis record for each attendance per subject in the form of ICD-10. To calculate continuity of care index without outliers, we excluded patients who attended less than 4 times and also eliminated those who attended more than 100 times during the follow up period[12].

For these attendances, we identified the primary care provider for each patient, the most frequently visited clinic by the subject. We selected patients whose primary care provider was clinic-based (N=39,130) to focus on the continuity in primary care environment. Lastly, patients under age 20 were excluded (N=39,096). For example, if a known diabetic patient who attended local clinics 5 times between 2014-2015 for their diabetes care had a primary care provider based in a general hospital, they would be excluded from the analysis.

Measures

Continuity of care

To measure the continuity of care, we calculated three continuity care indices for each variable; most frequent provider continuity (MFPC), the modified-modified continuity index (MMCI), and the continuity of care index (COC). These three indices must have a value between 0 and 1 intrinsically according to the formula below.

$$MFPC = \frac{Max\ (n_1, n_2, \cdots, n_M)}{N}$$

$$MMCI = \frac{1 - \frac{M}{N + 0.1}}{1 - \frac{1}{N + 0.1}}$$

$$COC = \frac{\sum_{i=1}^{M} n_i^2 - N}{N(N-1)}$$

N: total number of visits; M: total number of clinics visited; n_i: number of visits to ith care provider.

MFPC is the ratio of number of visits to primary care physician to total number of visits to all physicians, which shows the concentration of visits to the primary physician[13]. When calculating MMCI, the number of clinics the patient had visited is included. Therefore, MMCI also reflects the distribution across clinicians, which is not accounted in MFPC [14]. COC combines both characteristics of MFPC and MMCI, but also takes the degree of concentrated visits to each clinic into consideration[15]. Thus, if COC value was 0, it would indicate that the patient had visited a different clinician each time. If COC index was 1, it would mean the patient only visited a single physician for all their diabetes care.

Patient factors

The data includes basic patient information; age, sex, residential area, average monthly insurance premium, and the presence of disability. We defined the patients' ages as those at 2014 and divided the ages into four groups with ranges of 20 years each. Residential area was provided according to the administrative division-Gu, not the specific geographical information. We allocated the residential area into one of four groups: Seoul (capital city), Gyeonggi-do (province), Metropolitan city, and other areas. Average monthly insurance premium was also included in the data because it is correlated to household income. Although initially insurance premiums were graded from 1 to 10, lowest to highest, we further categorized the 10 grades into three groups: 1–3, 4–7, and 8–10. The presence of disabilities was arranged into three groups: absence, mild disability, and severe disability.

Clinic factors

We analyzed the most frequent care provider for each patient, established them as the primary care provider, and combined it with the given clinic information: specialty of primary physician, number of hired physicians and nurses, hospitalization facility, and geographical location. Although clinics may employ doctors with various specialities, only the single, main medical specialty that they report to the government was taken into account. For instance, even though an internist employed a dermatologist and a general practitioner, they would report as an internal medicine clinic. Medical specialities that were accountable for diabetes treatment of more than 1% of selected patients were included in our multivariable model.

Geographical relationship

This variable indicates whether the patient's residential area and their primary physician's clinic are located in the same Gu (Korean administrative district), and therefore, represents the geographical proximity of the two factors.

Statistical analysis

For each continuity index, patients were first categorized into two groups of high and low continuity group. The lower quartile (25th percentile) was used as the cut-off value to divide the groups. The median of all indices was equivalent to 1, an inappropriate value to discern the disparity of continuity between the groups. We employed the chi-squared test to evaluate the differences between low and high continuity groups for each baseline characteristic.

We applied multivariable logistic regression to investigate the association between level of continuity and each factor. There are three geographical variables: patient's residential area, clinic location, and concurrence of both factors. When performing multivariate analyses adjusted for patient factors and clinic factors, we excluded the primary physician's clinic location factor to ensure minimal confounding effect. Because there is no confirmed standard in continuity of diabetic patients, the most common group in each variable was selected as the reference group.

Odds ratios (OR) and their 95% confidence intervals (CI) were measured. All analyses were performed with SAS Enterprise Guide 7.1 (SAS Institute Inc., Cary, NC, USA), and two-sided P values <0.05 were considered statistically significant.

Results

Characteristics of the study population

A total of 39,096 patients were included in the study, and primary care provider information was identified for each patient. Of the study population, 20,153 (51.54%) were men, and the average age was 62.6. Over half of the patients visited internal medicine physician as their primary care providers (63.5%), and most of the primary care provider clinics hired a single physician (74.3%) and did not have registered nurses (66.7%). Most of the clinics did not have hospitalization facilities (85.4%).

People attended clinics for diabetes mellitus on average of 20.2 times (standard deviation 11.3) over the 2-year period, approximately once every 5 weeks. Approximately 50% of the patients followed up on a single clinic to treat their diabetes for 2 years, demonstrating high continuity. On average, subjects visited 1.6 clinics (standard deviation 0.9) to manage their diabetes. Mean value of continuity of care indices were 0.90 (standard deviation 0.16), 0.96 (standard deviation 0.08), 0.85 (standard deviation 0.21) using MFPC, MMCI, and COC respectively. We divided the patients into two groups of continuity based on the lower quartile (25th percentile) value of each index. The cut-off limits that were applied for lower quartile indices values were 0.83, 0.98, 0.70 for MFPC, MMCI, and COC, respectively.

Age, residential area, presence of disability, physician specialty, location of clinic, hospitalization facility, and distance between the location of the patient and their own primary care clinic showed significant differences in distributions of the lower and higher MFPC, MMCI, and COC groups (P <0.05). Number of physicians and registered nurses showed statistical incongruity among indices.

Patient factors

We used multivariate logistic regression to discern the elements that were associated with greater continuity. For each continuity index, we used regression analyses to investigate the continuity of all baseline characteristics variable (table 1), excluding the clinic location variable.

We found that patients aged 20-39 (MFPC 0.75 [0.65-0.86], MMCI 0.73 [0.64-0.84], COC 0.73 [0.64-0.84]) and above 80 (MFPC 0.81 [0.74-0.89], MMCI 0.84 [0.76-0.92], COC 0.81 [0.74-0.89]) were associated with lower continuity of care. There was a significant statistical association between continuity, residential area and presence of disability. Patients living in metropolitan areas had higher continuity of care compared to those of other areas (metropolitan area, MFPC 1.19 [1.17-1.27], MMCI 1.17 [1.10-1.25], COC 1.19 [1.12-1.27]). Patients with mild disabilities showed lower continuity of care than those without such disabilities. However, patients with severe disabilities showed no significant differences in continuity compared to subjects without disabilities.

Clinic factors

Analysis on medical specialties of primary care physicians showed that general practitioners and orthopaedics were associated with lower continuity of diabetes. Family medicine was correlated to higher continuity, where as general surgery showed lower continuity; however, these two specialties demonstrated no statistical significance.

Geographical factors

Geographical discrepancy between a patient's residential area and their primary care clinic location demonstrated significantly lower continuity of care (MFPC 0.74 [0.70–0.78], MMCI 0.70 [0.66–0.73], COC 0.74 [0.70–0.78]).

Discussion

Diabetic patients in Korea in average had high continuity of care, which was consistent with previous studies[10, 11]. In the current study, continuity of diabetes care was significantly higher in patients who were middle aged (40-59); who lived in metropolitan areas; who did not have disabilities; who visited internists; who lived in proximity to their primary care providers.

Earlier studies show that gender and type of medical institution were few of the factors related to continuity. However, we included information that may reveal more significance with continuity of care, such as specialty of physician, number of hired physicians and nurses per clinic, and geographical relationship. In addition, we used claim data from a population-based cohort which represents the general population of South Korea. Current study showed consistent results among the three continuity indices, verifying the reliability of our data.

Age is not only related to the prevalence of type 2 diabetes, but is also associated with continuity of care of the disease. There was a definite increase of continuity in age group 40-59, compared to other age groups. Continuity was distinctively lower in young age group (20-39), which can partly be explained by milder severity of disease, less complication, and more frequent residential migration of the group. However, current phenomenon can pose an impending threat to the working population, since legacy effect of diabetes has been recently reported[16]. That said, our analysis showed that continuity also declines in patients over the age 80. In the elderly population, frailty[17] is an important issue that is especially prevalent in the presence of chronic diseases [18]. Frailty has a negative impact on activities of daily living[19], such as visiting doctors, ultimately resulting in lower continuity of care. Thus, healthcare policies to enhance continuity in older age group is imperative to lighten the socioeconomic disease burden for the rapidly ageing global population [20,21].

As supported by earlier studies, our results showed lower continuity in patients with disabilities[22]. But we further examined how continuity of care differed between participants with mild disabilities and severe disabilities: patients with mild disabilities showed lower continuity. This is not only because severely disabled patients have higher hospital visit rates, but also because disability related policies are mostly targeted at more severely disabled patients [23, 24]. Those with mild disability are socially disadvantaged, which indicates that more social, political attention has to be provided for their well-being.

To our knowledge, there has been no research exploring the correlation between continuity and geographical proximity of a patient's residential area and primary care location. Our results showed that more than 30% of sample cohort patients visited clinics in different administrative districts from that of their home, which lead to a marked decline in continuity. This conveys the large disparity between supply and demand of medical resources in Korea. 2019 American Diabetes Association guideline recommends that diabetic patients should meet their primary care givers every 2 to 3 months[2, 25]. Moreover, prevalence of diabetes is closely related to residential location[26], which implies local physicians can manage their

patients in more customized, communicative manner. In order to further improve continuity of care, we need a policy that would geographically align the supply and demand of chronic care needs.

We also investigated the association between continuity and factors related to clinics, such as the specialty of primary clinician, number of physicians and nurses per clinic, and hospitalization facility. Our data trend indicated that solo practice, group practice, hospitalization facility, and number of hired nurses did not have an impact on continuity. These surrogate markers convey that patients do not have preferences with regard to sizes of office-based clinics. In contrast, specialty of primary physicians and continuity showed a range of statistical relevance. Continuity was lower in diabetic patients who visited general practitioners than in those who visited internists. This implies that patients prefer specialist care, even when managing chronic diseases. Raising awareness of primary care environment is essential for future healthcare planning[27, 28].

Current study had several limitations. We measured and analyzed factors associated with continuity in more breadth, but did not include frailty or psychological factors which could also affect continuity. Secondly, although we analyzed direct association between variables and continuity of care, we do not know how different factors interact with each other. Further qualitative research based on interviews will be needed to examine the dynamic relationships among the factors of continuity.

The main strength of our study is the use of nationwide, representative, large cohort data that can be generalized for the South Korean population. Such research is valuable for identifying more factors associated with continuity of care. Furthermore, regular follow up studies conducted in similar settings can monitor behavioral changes in primary care environment and assess impact of healthcare policies.

Conclusions

Continuity of diabetes is affected by various factors associated with patients, clinics, and location of clinics. Among these factors, geographical proximity of primary care clinic and patient’s residence confirmed significant correlation with high continuity of care. Policy to geographically support the supply and demand of chronic care needs is necessary to promote continuity in diabetic patients.

List Of Abbreviations

NHIS (National Health Insurance Service)

OR (Odds ratio)

CI (Confidence interval)

MFPC (Most frequent provider continuity index)

MMCI (Modified-modified continuity index)

COC (Continuity of care index)

Declarations

Ethics approval and consent to participate: This study was exempt from ethics review board, because all data were fully unidentifiable.

Consent for publication : Not applicable

Availability of data and materials: The datasets analyzed during the current study are available in the National Health Insurance sharing service repository, https://nhiss.nhis.or.kr.

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Authors contributions: Ji Yeh Shin was the major contributor in writing most of the manuscript. Ha Jin Kim and Jae Moon Yun analyzed the dataset and contributed in writing some of the manuscript. BeLong Cho, Yun Jun Yang and Jae Moon Yun were involved in the study design and revision of manuscript. All authors read and approved the final manuscript.

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Tables

Due to technical limitations, table 1, 2 is only available as a download in the Supplemental Files section.

Figures

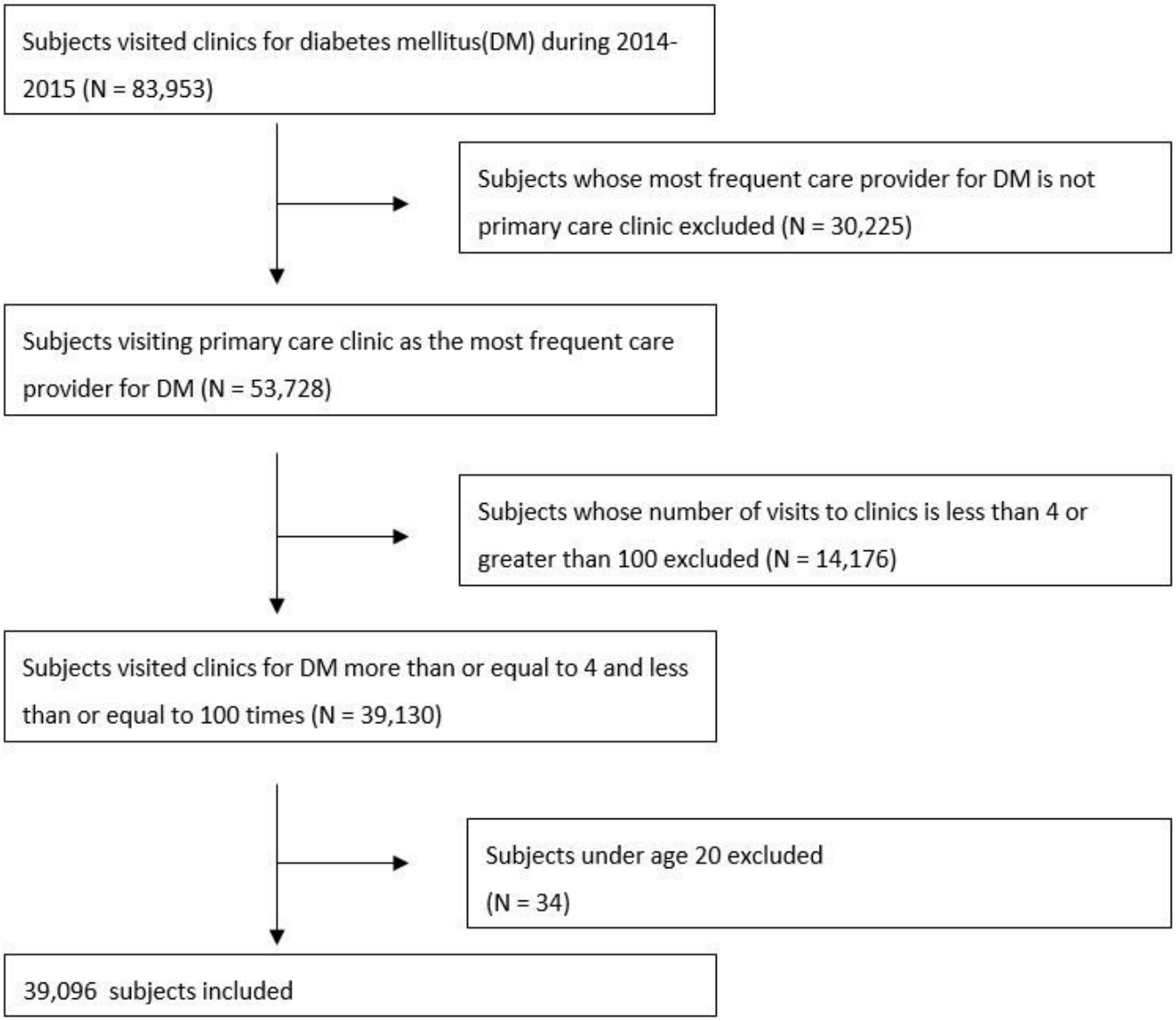

Figure 1

Flowchart showing selection of subjects

Supplementary Files

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