Analysis of Continuity of Care and Related Factors in Diabetes 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 area had higher continuity of care compared to 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 number of hired 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 highest 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 worldwide¹. 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 comorbidities². An evidence-based analysis review of multiple RCTs, systematic reviews, and observational studies reported that higher continuity of diabetes patients were associated with fewer hospitalization rates, lower HbA1c levels, and less ER visits²³⁴. A study on interpersonal continuity in diabetes patients also revealed better patient satisfaction and lower mortality rates in diabetes patients with higher continuity of care⁵⁶.

As continuity of care received increasing attention⁷⁸, numerous studies attempted to evaluate the factors of continuity to apply to primary healthcare environment. Factors associated with the level of continuity

were categorized into population demographic, patient factors, quality of care⁹, and interpersonal relationships – between patient and physician⁵. Yet many of the factors mentioned were determined based on surveys and interviews, making it susceptible to bias.

Recent studies carried out in Korea reported that gender, comorbidity, income, types of medical institution were correlated to continuity of care in diabetes^{10,11}. Although the association of continuity and geographical proximity of primary care clinics may seem obvious, it has not been investigated before.

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.

Methods

Data source and study population

This study used claim data from the National Health Insurance Service (NHIS) National Sample Cohort, which is a population-based cohort. The cohort had been first sampled in 2002 NHIS database and had been followed up until 2017. The NHIS enrollees cover approximately 97% of all Koreans, and with 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 clinics for diabetes mellitus based on diagnosis record. The 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 ones who attended more than 100 times during the follow up period¹².

For further subject selection, we reflected the type of medical institution (e.g. primary clinic, general hospital) each patient attended with their main diagnosis of diabetes mellitus. For these attendances, we identified the primary care provider for each patient, which was the one clinic that the subject visited most frequently. We selected patients whose primary care provider was clinic-based (N=39,130), not a general hospital, to focus on the continuity in primary care environment. Lastly, patients under age 20 was excluded (N=39,096).

An additional pptx file of Figure 1 shows here [see Additional file 1]

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.

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

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

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

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

MFPC is the ratio of number of visits to regular physician to total number of visits to all physicians, which shows the concentration of visits to the primary physician¹³. 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 MFPC¹⁴. COC combines both characteristics of MFPC and MMCI, but also takes the degree of concentrated visits to each clinic into consideration¹⁵. Therefore 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 include basic patient information; age, sex, residential area, average monthly insurance premium, and the presence of disability. We defined patients' age as at 2014 and divided age into four groups with ranges of 20 years each. Residential area is provided according to the administrative division-Gu, not the exact geographical information and we allocated the area into one of four groups: Seoul (capital city), Gyeonggi-do (province), Metropolitan city, and other areas. The average monthly insurance premium was included in the data because it correlates with household income. Originally, insurance premiums were classified into grades from 1 to 10, from the lowest income to the highest. We categorized the 10 grades into three groups: grades 1–3, 4–7, and 8–10. The presence of disability was also included as a groups: absence, mild disability, and severe disability.

Clinic factors

We analyzed the most frequent care provider for each patient, and established them as the primary care provider, and combined it with the 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 in account. Medical specialities that were accountable for more than 1% of type 2 diabetes management was 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, representing the geographical proximity of the two factors.

Statistical analysis

Patients were first categorized into two groups of high and low continuity group, for each continuity index. The lower quartile (25th percentile) was used as the cut-off values to divide the groups. The median of all indices were equivalent to 1, which is 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; concurrence of both factors. When performing multivariate analyses adjusted for patient factors and clinic factors, primary physician's clinic location factor was excluded to ensure minimal confounding effect. Because there is no confirmed standard in continuity of diabetes 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 to 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 had single physician (74.3%) and did not hire 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, which is approximately once every 5 weeks. Approximately 50% of the patients followed up a single clinic to treat their diabetes for 2 years, which demonstrates high continuity. On average, subjects visited 1.6 clinics (standard deviation 0.9) to manage their diabetes. Mean value of continuity of care indices are 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 was applied for lower quartile indices values were 0.83, 0.98, 0.70 for MFPC, MMCI, and COC, respectively.

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

An additional excel file of Table 1 shows here [see Additional file 2]

Patient factors

We used multivariate logistic regression to discern the elements that was associated with greater continuity. For each continuity index, we used regression analyses to investigate the continuity of all baseline characteristics variable (table 1), excluding 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 association between continuity and residential area and disability. Patients living in metropolitan area had higher continuity of care compared with the 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 disability showed lower continuity of care than those without such disability; but severe disabilities showed no difference compared to subjects without disability.

Clinic factors

From the perspective of the medical specialty, general practitioner and orthopaedics indicated lower continuity of diabetes. Family medicine physician showed higher continuity, where as general surgeon showed lower continuity, but these trends demonstrated no statistical significance.

Geographical factors

Considering the geographical relationship between patients and their primary care clinic, geographical discrepancy between a patient's residential area and the clinic's 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]).

An additional excel file of Table 2 shows here [see Additional file 3]

Discussion

Diabetes patients in Korea in average had high continuity of care, which is consistent with previous studies^{10,11}. In the current study, continuity of diabetes care was evidently higher in patients who were middle aged(40–59); who lived in metropolitan area; who did not have disability; who visited an internist; who lived in proximity to their primary care provider.

Earlier studies show that gender and type of medical institution are few of the factors related to continuity. However, we included information that may demonstrate more significance with continuity, 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, which verifies the reliability of our data.

Age is not only related to 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(20–39), which can partly be explained by mild severity, 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 reported¹⁶. That said, our analysis showed that continuity also declines in patients over 80. In the elderly population, frailty¹⁷ is an important issue that is especially prevalent in the presence of chronic diseases¹⁸. Frailty has a negative impact on activities of daily living¹⁹, such as visiting doctors, which eventually results 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 disability²². But we further examined how continuity of care differed between participants with mild disability and severe disability: patients with mild disability 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 patient's residential area and primary care location. Our results show that more than 30% of sample cohort patients visited clinics in different administrative district than 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 diabetes patients should meet their primary care givers every 2 to 3 months^{2,25}. Moreover, prevalence of diabetes is closely related to residential location²⁶, which implies local physicians can manage their patients in a 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 regards to sizes of office-based clinics. In contrast, specialty of primary physicians and

continuity showed a range of statistical relevance. Continuity was lower in diabetes patients who visited general practitioners than in those who visited an internist. This implies that patients prefer specialist care, even when managing chronic diseases. Raising awareness about 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 have correlation with continuity. Secondly, although we analyzed direct association between variables and continuity, 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 South Korean population. Such research is meaningful for identifying more factors associated with continuity of care. Furthermore, regular follow up studies of 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 diabetes 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>.

Competing interests: The authors declare that they have no competing interests.

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Authors contributions: JYS was the major contributor in writing most of the manuscript. HJK analyzed the dataset and contributed in writing some of the 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

This is a list of supplementary files associated with this preprint. Click to download.

- [Additionalfile3Table2.xlsx](#)

- [Additionalfile2Table1.xlsx](#)
- [Additionalfile1Figure1.pptx](#)