Impact of Continuity of Care on Mortality and Health Care Costs: A Nationwide Cohort Study in Korea

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ABSTRACT

PURPOSE Continuity of care is considered a core element of high-quality primary care, but its impact on mortality and health care costs is unclear. We aimed to determine the impact of continuity of care on mortality, costs, and health outcomes in patients with newly diagnosed cardiovascular risk factors.

METHODS We conducted a cohort study of a 3% nationwide random sample of Korean National Health Insurance enrollees. A total of 47,433 patients who had received new diagnoses of hypertension, diabetes, hypercholesterolemia, or their complications in 2003 or 2004 were included. We determined standard indices of continuity of care—most frequent provider continuity (MFPC), modified, modified continuity index (MMCI), and continuity of care index (COC)—and evaluated their association with study outcomes over 5 years of follow-up. Outcome measures included overall mortality, cardiovascular mortality, incident cardiovascular events, and health care costs.

RESULTS The multivariable-adjusted hazard ratios (HRs) for all-cause mortality, cardiovascular mortality, incident myocardial infarction, and incident ischemic stroke comparing participants with COC index below the median to those above the median were HR = 1.12 (95% CI, 1.04-1.21), 1.30 (1.13-1.50), 1.57 (1.28-1.95), and 1.44 (1.27-1.63), respectively. Similar findings were obtained for other indices of continuity of care. Lower continuity of care was also associated with increased inpatient and outpatient days and costs.

CONCLUSIONS Lower indices of continuity of care in patients with newly diagnosed hypertension, diabetes, and hypercholesterolemia were associated with higher all-cause and cardiovascular mortality, cardiovascular events, and health care costs. Health care systems should be designed to support long-term trusting relationships between patients and physicians.

Ann Fam Med 2014;12:534-541. doi: 10.1370/afm.1685.

Conflicts of interest: authors report none.

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INTRODUCTION

Continuity of care, defined as a sustained partnership between patient and clinician, is considered a core element of high-quality primary care.[1,2] Theoretically, a "personal doctor" with accumulating knowledge of the patient's history and values could provide better care at lower cost.[3] However, changes in health care management, including shifts toward multidisciplinary group practices and forced discontinuities due to insurance change, are undermining continuity of care in the United States[4-6] and elsewhere.[7-9] As a consequence, there is substantial interest in understanding the role of continuity of care in determining health care outcomes and costs.[10]

Continuity of care has been associated with better quality of care[11,12] and with improved patient adherence and self-management,[11,13-15] improved outcomes,[15,16] and lower health care utilization and costs,[17-22] but the evidence is inconsistent.[23-26] Furthermore, previous studies have often been affected by methodological limitations,[2] including unrepresentative samples,[12,15,17,18,21] use of non-validated measures for continuity of care and outcomes,[11,14,17,18] temporal ambiguity in the relationship between continuity of care and outcomes,[12,17,18,20,21] and short follow-up.[15,21,22,27,28] Only one cohort study has found that continuity of care with a primary care physician was associated with lower mortality.[29] However, the study was restricted to older adults, and it did not investigate potential mechanisms of the association. Recent studies from the United Kingdom also suggest the association between continuity of care and reduced mortality, but they were limited by inconsistent results and the cross-sectional nature of one study.[30,31]

We aimed to determine the impact of continuity of care on survival and health care costs in patients with newly diagnosed cardiovascular risk factors, since these represent important, preventable chronic conditions[32,33] to which continuity of care is likely to be highly relevant.[11,15,34-37] In South Korea, virtually all Koreans (97%) are covered by National Health Insurance (KNHI), and may consult any primary care physician. (In Korea, primary care physicians work mostly in solo private practices and are reimbursed on a fee-for-service basis.) This system enables patients to choose and retain an individual physician regardless of changes in employment status. To that extent it promotes an ongoing interpersonal relationship between patient and physician and provides an excellent opportunity to evaluate the consequences of continuity of care.[38]

METHODS

Study Population

We studied a 3% random sample (n = 1,162,234) of KNHI enrollees who were aged at least 20 years on December 31, 2002. Eliminating those who had submitted claims for cancer or cardiovascular disease in 2002 left 970,192 who were free of such disease at the end of 2002. From that pool, we then selected 48,347 subjects with new claims for the diagnosis of hypertension, diabetes, hypercholesterolemia, or their complications during 2003 or 2004 and at least 4 claims during the first 2 years after the initial visit. We chose those criteria for visit frequency[15,19,27,35,39] and time frame[18,29] on the basis of our literature review, considering that (1) it would be difficult to construct stable measures of continuity for patients with fewer visits[15,27]; (2) semiannual visits are the desirable minimum for the management of the target conditions; and (3) a 2-year window may ensure longitudinal continuity.[29] After excluding 974 subjects who died during the first 2 years after their first visit, a total of 47,433 subjects were included in our study (Figure 1).

In Korea, biennial health check-ups are provided to KNHI enrollees aged 40 years and older and to all employees or employers regardless of age.[40] The program is targeted to the identification of chronic disease risk factors, and patients receive educational counseling or referral for treatment as indicated. To determine the role of continuity of care independent of conventional lifestyle factors, which cannot be adjusted in claims data, we identified the subset of study participants who underwent screening in the health check-up program in 2003 to 2004 (n = 18,206; 38.4%) and obtained their lifestyle data, including smoking, drinking, and body mass index.

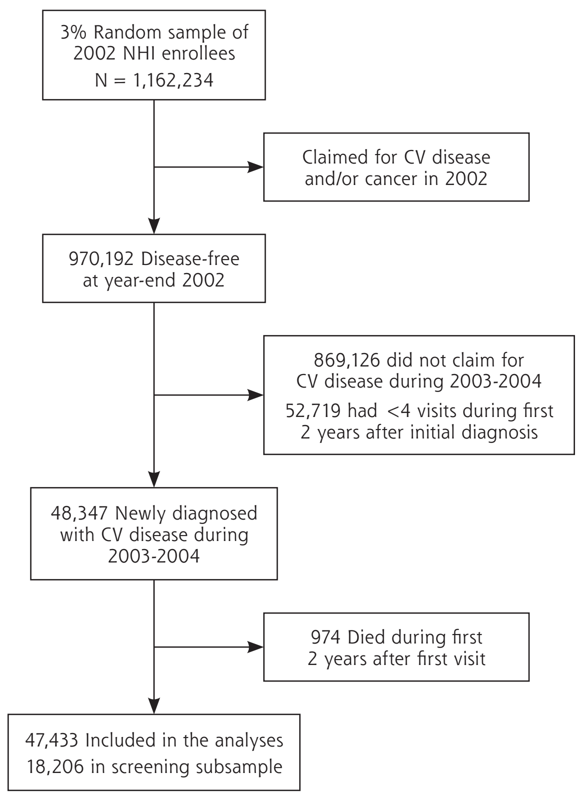
This study was approved by the Institutional Review Board of the Seoul National University. The requirement for informed consent was waived because the study was based on routinely collected administrative or claims data.

Data Sources and Measures

KNHI collects all necessary information for reimbursement of each medical service, including basic patient information, identifier for clinic or hospital, disease code, and costs incurred. Patient information includes age, sex, average monthly insurance premium (a proxy for household income), and residential area (categorized as city area, metropolitan area, and rural area).

Continuity of care was measured with 3 commonly used indices[19,41]: most frequent provider continuity (MFPC),[42] modified, modified continuity index (MMCI),[27,43] and continuity-of-care index (COC)[44] (Sup-

Figure 1. Flowchart of study participants.



NHI = National Health Insurance; CV = cardiovascular.

plemental Appendix 1). MFPC primarily measures the concentration of visits with the clinician most often seen, while MMCI focuses on the dispersion across clinicians,[27] and COC integrates both aspects into a single metric.

The primary outcome of the study was all-cause mortality. Secondary outcomes were cardiovascular mortality, as identified from death certificate data in the national death registry, and incidence of myocardial infarction, ischemic stroke, and hemorrhagic stroke, as identified only from inpatient hospital claim records to minimize bias from overcoding.

Health care utilization and health care cost incurred were calculated using KNHI claims data and included number of inpatient and outpatient days and expenses claimed with diagnosis codes of hypertension, diabetes, hypercholesterolemia, or related conditions during the period from 2005 to 2010. Pharmaceutical costs were not included.

Statistical Analysis

The primary analysis was based on Cox proportional hazards models in which continuity of care was measured in the first 2 years after diagnosis and outcomes accrued in subsequent years. Survival time was thus calculated as the time between 2 years after diagnosis and the date of death (or date of first hospitalization for cardiovascular outcomes), or December 31, 2010, whichever was first. Considering the highly skewed distribution of the indices, each index of continuity of care was dichotomized at its median. A sensitivity analysis was performed excluding the last 1 year before death to see if continuity of care antecedent to this point is significantly related to subsequent mortality.

For secondary analysis, we used a time-dependent Cox proportional hazards model in which each continuity-of-care index was calculated for each 2-year interval from the date of diagnosis[29] and dichotomized within each time frame. If the visit frequency was less than 4 during a 2-year time frame, continuity of care was considered to be low, since such low visit frequency would not be sufficient for appropriate management of chronic conditions. Additional sensitivity analysis was performed, separating the continuity of care levels into *above median, below median,* and *less than 4 visits*.

Multivariate analyses were performed by adjusting for age,[18,27] sex,[18,27] income, Charlson comorbidity index based on claims data in the year before diagnosis,[18,27,29] number of visits during the first 2 years,[18,27] and residential area.[27] To examine whether the association of continuity-of-care measures with outcomes could be confounded by other health behaviors, we performed sensitivity analyses in the screening subset, which allowed further adjustment for smoking status (current, past, never),[29] drinking status (current drinker vs others),[29] and body mass index (categorized as <18.5, 18.5-23, 23-25, or >25 according to Asian obesity criteria).[29] Further sensitivity analyses were performed in the secondary analysis, with Charlson comorbidity index, number of visits, and visits to tertiary-care hospitals in the previous years as additional time-dependent covariates.

Inpatient and outpatient days and costs were calculated by summing all days and costs during 2005-2010. Results for the high- and low-continuity groups were compared using multivariable linear regression models. All analyses were performed with SAS 9.2 (SAS Institute) and Stata 12.0 (Stata Corp). Two-sided *P* values <0.05 were considered statistically significant.

RESULTS

The mean age of study participants was 54.2 (SD = 12.5) years, with similar proportions of females and males. The average number of visits during the first 2 years was 14.4 (SD = 7.9) (Table 1). The median values of

Table 1. Description of Study Population (N = 47,433)

Characteristics	Value
Age, years	
Mean (SD)	54.2 (12.5)
Median (range)	54 (20-100)
Sex, No. (%)	
Male	24,060 (50.7)
Female	23,373 (49.3)
Premium in Korean won[a]	
Mean (SD)	45,567 (37,077)
Income level, No. (%)	
1st quartile; low	12,062 (25.4)
2nd quartile	11,692 (24.6)
3rd quartile	12,360 (26.1)
4th quartile; high	11,319 (23.9)
Place of residence, No. (%)	
Metropolitan area	24,742 (52.8)
City area	16,830 (35.9)
Rural area	5,327 (11.4)
Charlson comorbidity score	
Mean (SD)	0.49 (0.81)
Median (range)	0 (0-11)
Number of visits, mean (SD)	
During the first 2 years	14.4 (7.9)
During the second 2 years	14.2 (10.9)
During the third 2 years	15.7 (14.7)
Continuity of care indices, median (interquartile range)	
Most frequent provider continuity (MFPC)	0.88 (0.67-1.00)
Modified, modified continuity index (MMCI)	0.93 (0.84-1.00)
Continuity of care index (COC)	0.77 (0.49-1.00)

[a] $1 (US) = ₩1,100 (Korean won), as of 2012.

Table 2. Risk of Death and Cardiovascular Endpoints by Level of Continuity of Care (N = 47,433)

	Most Frequent Provider Continuity		Modified, Modified Continuity Index		Continuity of Care Index	
Endpoint	**Above Median**	**Below Median**	**Above Median**	**Below Median**	**Above Median**	**Below Median**
All cause mortality						
No. of deaths (deaths per 1,000 py)	1,340 (11.5)	1,787 (15.4)	1,296 (11.3)	1,831 (15.5)	1,345 (11.6)	1,782 (15.4)
Crude HR (95% CI)	1.00 (Ref)	1.33 (1.24-1.43)	1.00 (Ref)	1.37 (1.28-1.47)	1.00 (Ref)	1.33 (1.24-1.43)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.13 (1.05-1.21)	1.00 (Ref)	1.13 (1.05-1.21)	1.00 (Ref)	1.12 (1.04-1.21)
Cardiovascular mortality						
No. of deaths (deaths per 1,000 py)	321 (2.8)	494 (4.3)	299 (2.6)	516 (4.4)	321 (2.8)	494 (4.3)
Crude HR (95% CI)	1.00 (Ref)	1.54 (1.34-1.77)	1.00 (Ref)	1.67 (1.45-1.93)	1.00 (Ref)	1.54 (1.34-1.77)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.30 (1.12-1.50)	1.00 (Ref)	1.40 (1.21-1.62)	1.00 (Ref)	1.30 (1.13-1.50)
Noncardiovascular mortality						
No. of deaths (deaths per 1,000 py)	1,019 (8.8)	1,293 (11.1)	997 (8.7)	1,315 (11.2)	1,024 (8.8)	1,288 (11.1)
Crude HR (95% CI)	1.00 (Ref)	1.27 (1.17-1.38)	1.00 (Ref)	1.28 (1.18-1.39)	1.00 (Ref)	1.26 (1.16-1.37)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.07 (0.99-1.17)	1.00 (Ref)	1.05 (0.96-1.14)	1.00 (Ref)	1.07 (0.98-1.16)
Myocardial infarction[a]						
No. of incident events (incident events per 1,000 py)	144 (1.2)	232 (2.0)	147 (1.3)	229 (1.9)	144 (1.2)	232 (2.0)
Crude HR (95% CI)	1.00 (Ref)	1.61 (1.31-1.98)	1.00 (Ref)	1.51 (1.23-1.86)	1.00 (Ref)	1.62 (1.31-1.99)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.57 (1.27-1.94)	1.00 (Ref)	1.51 (1.22-1.87)	1.00 (Ref)	1.57 (1.28-1.95)
Cerebral infarction[b]						
No. of incident events (incident events per 1,000 py)	427 (3.8)	668 (6.0)	422 (3.8)	673 (6.0)	427 (3.8)	668 (6.0)
Crude HR (95% CI)	1.00 (Ref)	1.59 (1.41-1.80)	1.00 (Ref)	1.58 (1.40-1.78)	1.00 (Ref)	1.60 (1.41-1.80)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.43 (1.27-1.62)	1.00 (Ref)	1.43 (1.26-1.63)	1.00 (Ref)	1.44 (1.27-1.63)
Cerebral hemorrhage[b]						
No. of incident events (incident events per 1,000 py)	141 (1.2)	184 (1.6)	136 (1.2)	189 (1.6)	141 (1.2)	184 (1.6)
Crude HR (95% CI)	1.00 (Ref)	1.30 (1.05-1.62)	1.00 (Ref)	1.35 (1.08-1.68)	1.00 (Ref)	1.31 (1.05-1.63)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.19 (0.95-1.49)	1.00 (Ref)	1.20 (0.96-1.52)	1.00 (Ref)	1.19 (0.95-1.49)

CI = confidence interval; HR = hazard ratio; py = person-year; Ref = reference value.

[a] Multivariable adjustments included age, sex, income, Charlson comorbidity index, number of visits during the first 2 years, and residential area (for detail, see text).

[b] Excluding those who developed the indicated outcome during the first 2 years after diagnosis.

MFPC, MMCI, and COC were 0.88 (interquartile range, 0.67-1.00), 0.93 (0.84-1.00), and 0.77 (0.49-1.00), respectively. During 5 years of follow-up, we observed 3,127 deaths (13.5 per 1,000 person-years). The numbers of incident cases of myocardial infarction, ischemic stroke, and hemorrhagic stroke were 376, 1,095, and 325, respectively (1.6, 4.9, and 1.4 per 1,000 person-years, respectively). The screening subset showed similar demographic and health care use characteristics (Supplemental Appendix 2).

Patients with continuity-of-care measures below the median were at increased risk of mortality compared with those with continuity of care above the median (Table 2). The multivariable-adjusted hazard ratios (HR) for all-cause mortality comparing patients below to patients above median MFPC, MMCI, and COC values were as follows: HR = 1.13 (95% CI, 1.05-1.21), 1.13 (1.05-1.21), and 1.12 (1.04-1.21), respectively. The impact of continuity of care on mortality was largely restricted to cardiovascular mortality. The hazard ratios for cardiovascular mortality comparing patients below to patients above median MFPC, MMCI, and COC values were 1.30 (1.12-1.50), 1.40 (1.21-1.62), and 1.30 (1.13-1.50), respectively, while the corresponding estimates for non-cardiovascular mortality were 1.07 (0.99-1.17), 1.05 (0.96-1.14), and 1.07 (0.98-1.16), respectively. Neither using continuity-of-care indices as continuous variables nor excluding the last 1 year before death from the analysis changed the results (results not shown).

The association of measures of continuity of care with the risk of incident myocardial infarction and ischemic stroke were markedly stronger (Table 2). For instance, the hazard ratios comparing patients above to those below median levels of COC were 1.57 (95% CI, 1.28-1.95) and 1.44 (1.27-1.63) for myocardial infarction and ischemic stroke, respectively. The associations for hemorrhagic stroke were weaker and not statistically significant.

The findings were consistent when the analysis was based on updated measures of continuity of care in time-dependent analyses (Table 3), and when the analyses were restricted to patients in the screening subset even after further adjustment of smoking, alcohol consumption, and body mass index (Supplemental Appendixes 3 and 4). Neither 3-level classification of the continuity of care nor inclusion of Charlson comorbidity index, number of visits, and visits to tertiary-care hospitals in the previous years as additional time-dependent covariates changed the results (Supplemental Appendixes 5 to 7).

Continuity-of-care measures were also associated with inpatient and outpatient days and costs. Patients with above-median COC had significantly fewer ($P < 0.001$) inpatient and outpatient days and lower inpatient and outpatient costs compared with patients with below-median COC (Table 4). The differences for MFPC and MMCI were very similar. The findings in the subsample of patients with additional adjustment were also consistent (Supplemental Appendix 8).

DISCUSSION

In this large cohort study of patients with newly diagnosed hypertension, diabetes, or hypercholesterolemia, higher continuity of care was associated with lower overall and cardiovascular mortality, lower incidence of cardiovascular events, and reduced health care utilization and costs, even after controlling for potential confounders including comorbidities and total number of clinician visits. Our study is the first to show a survival benefit of increased continuity of care in a representative sample of newly diagnosed patients. The use of newly diagnosed patients, the large sample size, the high follow-up rate, and the robustness of our findings irrespective of choice of continuity measure, analytical methods, and covariate adjustment, add to the strength of our study. While our findings cannot be generalized to other conditions, our results suggest that continuity of care is a robust predictor of outcomes in patients for conditions with available effective preventive interventions.

Findings and Possible Explanations

We found an inverse association between continuity of care and future clinical cardiovascular outcomes. A physician who attends the same patient regularly is likely to have better knowledge of him or her, to recognize problems earlier,[45] and to provide higher quality of care.[11,12] Furthermore, patients who have continuity with the same physician are more likely to adopt

Table 3. Risk of Death and Cardiovascular Outcomes by Level of Continuity of Care in Time-Dependent Analyses (N = 47,433)

	Most Frequent Provider Continuity		Modified, Modified Continuity Index		Continuity of Care Index	
Outcome	**Above Median**	**Below Median**	**Above Median**	**Below Median**	**Above Median**	**Below Median**
All cause death						
Crude HR (95% CI)	1.00 (Ref)	1.48 (1.38-1.59)	1.00 (Ref)	1.49 (1.39-1.61)	1.00 (Ref)	1.48 (1.38-1.59)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.32 (1.23-1.42)	1.00 (Ref)	1.30 (1.21-1.41)	1.00 (Ref)	1.32 (1.23-1.42)
Cardiovascular mortality						
Crude HR (95% CI)	1.00 (Ref)	1.54 (1.34-1.78)	1.00 (Ref)	1.68 (1.46-1.94)	1.00 (Ref)	1.55 (1.34-1.78)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.30 (1.13-1.50)	1.00 (Ref)	1.40 (1.21-1.63)	1.00 (Ref)	1.31 (1.13-1.51)
Non-cardiovascular mortality						
Crude HR (95% CI)	1.00 (Ref)	1.27 (1.17-1.38)	1.00 (Ref)	1.29 (1.19-1.40)	1.00 (Ref)	1.27 (1.17-1.37)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.08 (0.99-1.17)	1.00 (Ref)	1.05 (0.96-1.14)	1.00 (Ref)	1.07 (0.99-1.16)
Myocardial infarction[b]						
Crude HR (95% CI)	1.00 (Ref)	1.56 (1.27-1.92)	1.00 (Ref)	1.45 (1.17-1.78)	1.00 (Ref)	1.54 (1.25-1.89)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.61 (1.30-1.99)	1.00 (Ref)	1.50 (1.22-1.87)	1.00 (Ref)	1.59 (1.28-1.96)
Cerebral infarction[b]						
Crude HR (95% CI)	1.00 (Ref)	1.52 (1.34-1.71)	1.00 (Ref)	1.51 (1.34-1.71)	1.00 (Ref)	1.54 (1.36-1.74)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	1.39 (1.23-1.58)	1.00 (Ref)	1.40 (1.24-1.60)	1.00 (Ref)	1.42 (1.25-1.61)
Cerebral hemorrhage[b]						
Crude HR (95% CI)	1.00 (Ref)	0.95 (0.76-1.18)	1.00 (Ref)	1.04 (0.83-1.29)	1.00 (Ref)	0.98 (0.79-1.22)
Multivariable-adjusted HR[a] (95% CI)	1.00 (Ref)	0.87 (0.69-1.08)	1.00 (Ref)	0.93 (0.74-1.17)	1.00 (Ref)	0.89 (0.71-1.12)

HR= hazard ratio; CI = confidence interval; Ref = reference standard.

[a] Multivariable adjustments included age, sex, income, Charlson comorbidity index, number of visits during the first 2 years, and residential area (for detail, see text).

[b] Excluding those who developed the indicated outcome during the first 2 years after diagnosis.

Table 4. Health Care Utilization and Costs by Level of Continuity of Care (N = 47,433)

Characteristic	Most Frequent Provider Continuity		Modified, Modified Continuity Index		Continuity of Care Index	
	Above Median	Below Median	Above Median	Below Median	Above Median	Below Median
Health care utilization, adjusted mean[a] (SE)						
Total inpatient days (2005-2010)	7.4 (0.4)	11.4 (0.4)	7.4 (0.4)	11.4 (0.4)	7.4 (0.4)	11.4 (0.4)
Difference (95% CI)	4.0 (2.8-5.2)		4.0 (2.8-5.2)		4.0 (2.9-5.2)	
Total outpatient days (2005-2010)	22.5 (0.2)	25.4 (0.2)	22.1 (0.2)	25.8 (0.2)	22.5 (0.2)	25.4 (0.2)
Difference (95% CI)	2.9 (2.3-3.4)		3.7 (3.1-4.2)		2.9 (2.3-3.5)	
Health care costs, 2005-2010, $ (US)						
Total inpatient cost, adjusted mean[a] (SE)	853.7 (31.7)	1294.5 (31.6)	844.7 (32.3)	1297.1 (31.7)	851.5 (31.7)	1297.3 (31.6)
Difference (95% CI)	440.9 (352.6-529.2)		452.4 (362.3-542.5)		445.7 (357.5-534.0)	
Total outpatient cost, adjusted mean[a] (SE)	457.5 (17.7)	574.6 (17.6)	446.5(18.0)	583.6 (17.7)	456.1 (17.7)	576.1 (17.6)
Difference (95% CI)	117.0 (67.7-166.3)		136.7 (86.5-187.0)		119.7 (70.5-169.0)	
Total cost, adjusted mean[a] (SE)	1311.1 (38.0)	1869.2 (37.9)	1291.3 (38.6)	1880.6 (38.0)	1307.7 (37.9)	1873.4 (37.9)
Difference (95% CI)	557.9 (452.3-663.5)		589.1 (481.4-696.9)		565.5 (459.8-671.2)	

CI = confidence interval; SE = standard error. $1 (US) = ₩1,100 (Korean won), as of 2012.

Note: All *P* values comparing above to below median utilization and cost parameters <0.001.

[a]Multivariable adjustments included age, sex, income level (quartile), Charlson comorbidity index, number of visits during the first 2 years, and residential area (for detail, see text).

better self-management behaviors[11,15] and to increase adherence to medication recommendations, probably because of greater trust[46-48] and to have higher satisfaction with their physicians.[47,49] Indeed, continuity of care has been associated with lower HbA_{1C} levels in patients with diabetes[11,15] and with lower blood pressure in hypertensive patients,[34] but our study provides for the first time a direct link between continuity of care, clinical end points, and all-cause and cause-specific mortality.

The increased mortality associated with lower continuity of care of patients with cardiovascular risk factors in our study was largely due to increases in cardiovascular mortality. In addition to cardiovascular mechanisms, patients who have a sustained relationship with a physician may receive other preventive services[11,14,17,22,48,50,51] and better quality of care for other comorbid conditions.[52] It is thus possible that continuity of care for cardiovascular chronic conditions may also result in reduced non-cardiovascular mortality, but in our data these collateral effects were only marginal.

Consistent with previous studies,[20] we also found reduced resource utilization and health care costs in subsequent years in groups with higher continuity of care. The association was stronger for inpatient care utilization and costs than for outpatient care costs,[17] suggesting that the main benefit of continuity of care was to reduce emergency department visits[19,21,22,28,35,53] and hospitalizations,[17,27,28,35] the most costly elements of health care. In addition, the reduction in cardiovascular complications seen in our study should also contribute to reduced resource utilization and health care costs. A previous study has reported increased test repetition with higher continuity of care,[26] but the implications of this finding were unclear, since this could be related to more careful disease monitoring.

Study Limitations

Several limitations need to be considered in the interpretation of our findings. First, we measured commonly used indices of continuity of care that assess informational and longitudinal continuity of care related to the pattern of visits. Interpersonal continuity, characterized by personal trust and responsibility in the relationship between patient and physician, represents a higher dimension in the hierarchical definition of continuity of care,[41,54] but it was not assessed in this study because its assessment requires subjective measures.[38] Informational and longitudinal continuity of care, however, are prerequisites for interpersonal continuity and provide a solid foundation for exploring higher dimensions of continuity of care.[38,39]

Second, we lacked details on process measures such as blood pressure, cholesterol, or HbA_{1C} levels as well as well as data on prescription treatments and compliance. Furthermore, the Charlson comorbidity index could not fully capture disease severity. Inclusion of such data in future studies is warranted to establish the mechanisms through which continuity of care leads to better outcomes.

Third, the observational nature of our study leaves room for unmeasured confounding and other potential sources of bias. For example, patients with mild conditions may show low compliance and continuity of care, or patients experiencing adverse health outcomes may change physicians. Also, continuity of care may be a marker of patient or health care system characteristics related to better health outcomes.[10,12,15] Randomized clinical trials, however, are impractical for evaluating continuity of care. Finally, our results were derived in a health care system with universal coverage, high level of access to care, and free choice of physician, and may not be generalizable to other health care systems with different structures.

Implications

In spite of these limitations, our findings have significant policy implications given the way health care systems are increasingly fragmented and cost containment is increasingly important. Our study provides much needed empirical evidence that continuity of care is associated with reduced mortality, morbidity, and health care expenses and may thus provide added value in the management of chronic conditions. Health care systems should be designed to support long-term trusting relationships between patients and physicians, and health policies should encourage patients to concentrate their care with one physician.[55]

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Submitted October 30, 2013; submitted, revised, May 22, 2014; accepted June 25, 2014.

Key words: continuity of care; mortality; cardiovascular diseases; health care costs

Funding support: This work was supported by a grant from the South Korean Ministry of Health & Welfare, No. 800-20110189.

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Prior presentation: This work was presented at the Spring meeting of the Korean Academy of Family Medicine, April 5, 2013, Daegu, Korea.

Supplementary materials: Available at http://www.AnnFamMed.org/content/12/6/534/suppl/DC1/

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