

Do Reduced Copayments Affect Mortality after Surgery due to Stroke? An Interrupted Time Series Analysis of a National Cohort Sampled in 2003-2012

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Background: The South Korean government introduced a policy in 2 phases, in September 2005 and in January 2010, for reducing copayments for patients with critical diseases, including stroke, to prevent excessive medical expenditures and to ease economic barriers. Previous studies of the effect of this policy were focused primarily on cancer. Therefore, we investigated the relationship between this policy and 1-year mortality after surgery among patients with stroke. *Methods:* We used data from the Korean National Health Insurance sampling cohort (n = 2173 in 2003-2012) and performed an interrupted time series analysis. *Results:* Approximately 26% of the patients died within 1 year after surgery. The time trends after reducing copayments from 10% to 5% (phase 2) were inversely associated with risk of 1-year mortality (relative risk = .855, 95% confidence interval: .749-.975; P = .0196). In addition, this inverse association was greater in patients with low incomes, of older ages, and with higher Charlson comorbidity indices. *Conclusions:* The introduction of a policy for reducing copayments to ease excessive cost burdens for patients with stroke was positively associated with a reduced risk of 1-year mortality after surgical treatment due to stroke. On the basis of our results, health policy makers should make an effort to identify vulnerable populations and to overcome economic barriers for providing effective alternatives to ensure patients receive optimal health care. **Key Words:** Stroke—mortality—copayment—time series—economic barrier.

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Background

Although the South Korean government introduced National Health Insurance (NHI) 30 years ago, many South Koreans still encounter certain health-care-related issues. During this period, problems due to acute diseases rapidly decreased in South Korea, but other issues related to increasing chronic diseases, including cancer, cardiovascular diseases, and cerebrovascular diseases, are emerging along with an aging population.^{1,2} As such, the burdens from these chronic diseases have considerably increased. Stroke is among these and is one of the most common causes of death worldwide, and has been identified as the second highest cause of death by the World Health Organization.³ Mortality due to stroke was also ranked as one of the major causes of death by Statistics Korea, ranking second in 1994 and remaining at third in 2014.⁴ In addition, a study using NHI data in South Korea found that the cost

burden due to stroke rapidly worsened after 2000; the compound annual growth of medical expenditures due to stroke was 13.2% in 2001-2009 (from 272 billion Korean won [KRW] in 2001 to 680 billion KRW in 2009).⁵ Despite the development of treatment strategies for stroke and the subsequent increase in survival (mortality due to cerebrovascular diseases decreased from 73.7% in 2001 to 53.2% in 2010),⁶ the cost burden among these patients remains an important obstacle.⁷ In addition, it was debated whether health insurance coverage for a vulnerable population with excessive medical expenditures was really appropriate in South Korea.⁸

In September of 2005, the South Korean government introduced a policy for reducing copayments for patients with critical diseases, including cardiovascular and cerebrovascular diseases, to prevent excessive medical expenditures and to ease the economic barrier to treatment.^{9,10} This policy was applied only to patients undergoing surgical treatments or medications who met the criteria for expanding coverage among patients with stroke. For these patients, copayments for costs accruing within 30 days after surgical treatment were discounted by 50%. This policy was expanded in 2 phases. After the first phase in September 2005, copayments for costs within 30 days of surgical treatment were reduced from 20% to 10%. In the second phase in January 2010, this 10% copayment was further reduced to 5%. These reductions were expected to result in many changes in health-care utilization and outcomes even though such coverage was applied only to a maximum of 30 days for patients with specific surgical treatments. Previous studies have shown that economic factors were associated with health outcomes in patients with stroke.^{11,12} Furthermore, reductions in copayments for patients with cancer have altered their behaviors during treatment and the corresponding medical expenditures.^{13,14} However, the impact of reducing copayments for patients with stroke has not been studied. We hypothesized that introducing this policy improved health outcomes in patients with stroke. To test this, we investigated the relationship between the implementation of this policy and mortality after surgical treatment in patients with stroke.

Methods

Study Population

We used the data from the Korean National Health Insurance sampling cohort collected in 2002-2013 by systematic sampling and comprising nationally representative random samples of 1,025,340 individuals. To investigate the association between mortality and the introduction of the policy for reducing copayments, we first included only patients who were diagnosed with stroke according to the *International Classification of Diseases*, version 10 (ICD-10): I60-63, and excluded patients who were diagnosed before 2003. Patients who

underwent the following surgical treatments were included: craniotomy for evacuation of a hematoma, operation for cerebral aneurysm, operation for cerebral arteriovenous malformation, intracerebral vascular anastomosis, shunt or bypass operations, cerebral lobectomy, operation on the skull base, central nervous system stereotactic operation for hematoma removal, percutaneous transluminal angioplasty, percutaneous cerebral angioplasty with drugs, percutaneous intravascular installation of a metallic stent, percutaneous thrombus removal, embolization, burr hole or trephination, craniotomy or craniectomy, intravascular atherectomy, carotid artery ligation, and endoscopic brain surgery. To consider 1-year mortality as the outcome variable in the present study, we excluded patients who were newly diagnosed with stroke in 2013 to ensure a follow-up period of more than 1 year. As a result, the data analyzed in the present study included 2173 patients who were diagnosed with stroke and who underwent surgical treatment at general and tertiary hospitals.

Variables

The outcome variable used in the present study was 1-year mortality after surgical treatment for stroke. The index date was defined as the first date of admission for the treatment.

Other variables included the introduction of the policy for reducing copayments and the elapsed time from this date. The study period was divided into "before" and "after" based on the introduction of the policy, and the point after the policy was divided into phases 1 (September-December 2005) and 2 (January 2010-December 2012) according to the phase of the policy implementation; the time before the policy was defined as 0, and the time after was defined as 1. Linear changes over time after the introduction of the policy were evaluated on a quarterly basis from 2004 to 2012; the 2 time trend variables were included based on the date of policy implementation (phases 1 and 2), and they were coded as 0 before the policy implementation and 1, 2, and 3 after the policy implementation, respectively. The baseline trends were stratified by quarter from 2004 to 2012.

We adjusted patient and hospital variables to investigate the association between the introduction of the policy and 1-year mortality. Patient variables were as follows: major diagnosis, sex, age, income, type of insurance coverage, region, Charlson comorbidity index (CCI), and year of admission for surgical treatment. The major diagnosis was defined based on ICD-10 coding as follows: subarachnoid hemorrhage, intracerebral hemorrhage, other nontraumatic intracerebral hemorrhage, and cerebral infarction. Patient ages were categorized (in years) as 49 or younger, 50-59, 60-69, and 70 or older. In the Korean National Health Insurance cohort data, income groups were categorized into deciles based on the premiums for

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