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Association between Stroke Quality Assessments and Mortality within 30 Days among Patients Who Underwent Hemorrhagic Stroke Surgeries in South Korea

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Keywords
Stroke · Hemorrhagic stroke · Quality assessment · Mortality · Volume performance

Abstract
Introduction: In South Korea, to improve the quality of medical services provided to stroke patients, stroke quality assessments have been implemented since 2006. To further promote improvement of care, financial incentives were introduced since 2012. This study aims to examine the association between stroke quality assessments and mortality within 30 days among South Korean adults who underwent hemorrhagic stroke surgeries to provide evidence of the importance of such assessments. ***Methods:*** Data from 45,741 patients from 374 healthcare organizations, derived from the 2013–2016 claims data of the Korean Health Insurance Review and Assessment Service, were examined. To ensure homogeneity, only patients who underwent hemorrhagic stroke surgeries were selected. Healthcare organizations were classified based on whether stroke quality assessments were conducted. The dependent variable of this study was death within 30 days of hospitalization. A generalized linear mixed model was constructed to analyze the association between variables. ***Results:*** Healthcare organizations without stroke quality assessments exhibited a higher risk of mortality than those that did (adjusted odds ratio [OR] = 1.53, 95% confidence interval [CI] = 1.16–2.01). Among healthcare organizations with the lowest volume, those without stroke quality assessments had a higher risk of mortality than those that did (tertile 1 [low], adjusted OR = 1.38, 95% CI = 1.04–1.84). Among rural healthcare organizations, those without assessments had a higher risk of mortality than did those that did (adjusted OR = 1.61, 95% CI = 1.06–2.43). ***Conclusions:*** The study identified a significant relationship between stroke quality assessments and 30-day mortality. Healthcare organizations without stroke quality assessments may exhibit a comparatively higher risk of mortality. Future interventions to minimize mortality and provide evidence for policymakers and healthcare leaders could involve expanding the scope of stroke quality assessment.

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Introduction

The World Health Organization describes stroke as a disease involving rapidly developing clinical signs of global disturbance of cerebral function, with symptoms lasting 24 h or longer or leading to death [1]. In South Korea, strokes have long been the second leading cause of death after cancer [2]. In 2015, the Korean Stroke Society targeted reducing the national burden of stroke by decreasing its incidence and the disabilities it causes by up to 10% within the next 10 years [3]. Therefore, various policies were implemented to actively prevent cerebrovascular diseases and minimize mortality and disability rates through appropriate treatment [4]. Monitoring mechanisms constitute an important policy strategy to improve quality of care, along with health system inputs, health system design, and system improvement [5, 6] and are employed in South Korea's competitive healthcare system, which also introduced financial incentives for high-performing healthcare providers to enhance effectiveness and quality of care [6].

To improve the quality of medical services provided to stroke patients, acute stroke quality assessment program conducted by Korean Health Insurance Review and Assessment Service (HIRA), which have been implemented since 2006, expanded their scope to promote better quality care through financial incentives in 2012 [7]. The stroke quality assessments are targeted at tertiary and general hospitals that assess 10 or more acute stroke admission cases [6]. The stroke quality assessment comprises 9 indicators (1 structural indicator, 7 process indicators, and 1 outcome indicator) that were considered to promote quality improvement and were developed by benchmarking the best practices of advanced countries and through consultations with an expert committee [6, 7]. The structural indicator measures the presence of a specialist (neurosurgery, neurology, and rehabilitation) [7]. The process indicators included brain imaging test within 1 h, rate of consideration of early rehabilitation within 5 days, rate of screening dysphagia, rate of tissue plasminogen activator therapy within 60 min, rate of consideration of tissue plasminogen activator therapy, rate of anticlotting drugs prescribed at discharge, and rate of anticoagulant drugs prescribed at discharge [6, 7]. Last, the outcome indicator included the results of each hospitalization (death or pneumonia within 30 days of the date of each hospitalization), which is not as yet included in the stroke quality assessment composite score [7]. The targeted hospitals were classified into 5 grades using the composite score. A composite score of over 95 was classified as first grade; 85–95, second grade; 75–85, third grade; 55–75, fourth grade; and under 55, fifth grade. Those healthcare organizations who were not the target of the stroke quality assessment remain without stroke quality assessment. The healthcare organizations that were classified in the top 20% or those who improved their composite score by >10 points compared to the previous year, were given incentives [7]. In addition to the quality assessment, HIRA conducted monitoring in targeted hospitals based on indicators such as ambulance utilization, median time of emergency arrival, and smoking cessation education, as these might influence quality [7].

When compared to high-volume hospitals, previous studies show that low-volume hospitals have poorer operative outcomes and survivals [8]. Moreover, surgeon volume was also shown to be related to postoperative mortality [8, 9]. One study revealed that low-volume surgeons had a higher overall risk of complications. However, although surgeon volume is highly associated with patient outcomes, the outcome of the surgery is reflective of all factors related to the surgeon, hospital, and patient [9]. Therefore, the outcome of complex surgical procedures may depend not only on how well the operation is performed but also on the available resources at the hospital [8].

Moreover, strokes result in not only mortality but also morbidities that affect the lives of survivors and their family members [10]. In 2016, 45.8 individuals per 100,000 died of cerebrovascular diseases, while 58.2 individuals per 100,000 died of heart diseases [11]. Moreover, healthcare organizations without stroke quality assessments may become negligent in management, thereby leading to differences in quality levels. Therefore, it is important to elucidate the effects of stroke quality assessments to provide valuable evidence to policymakers and healthcare professionals.

Specifically, it is crucial to investigate the association between stroke quality assessment and mortality within 30 days, which could help protect stroke patients by ensuring that hospitals conduct timely medical interventions. Therefore, this study hypothesizes that stroke quality assessment is strongly associated with lower risk of mortality. We seek to emphasize the importance of receiving stroke quality assessment, highlighting the role of policymakers and healthcare leaders in expanding its scope.

Table 1. General characteristics of the study population

Variables	Total		Mortality within 30 days				*p* value
			death		alive		
	N	%	*N*	%	*N*	%	
Total (*N* = 45,741)	45,741	(100.0)	4,424	(9.7)	41,317	(90.3)	
Hospital characteristics (374 healthcare organizations)							
Stroke quality assessment							
Yes (206 healthcare organizations)	44,222	(96.7)	4,181	(9.5)	40,041	(90.5)	<0.0001
No (168 healthcare organizations)	1,519	(3.3)	243	(16.0)	1,276	(84.0)	
Volume							
Tertile 1 (low; 314 healthcare organizations)	15,124	(33.1)	1,884	(12.5)	13,240	(87.5)	
Tertile 2 (35 healthcare organizations)	14,933	(32.6)	1,281	(8.6)	13,652	(91.4)	<0.0001
Tertile 3 (high; 25 healthcare organizations)	15,684	(34.3)	1,259	(8.0)	14,425	(92.0)	
Region of hospital							
Urban area (227 healthcare organizations)	34,652	(75.8)	3,124	(9.0)	31,528	(91.0)	<0.0001
Rural area (147 healthcare organizations)	11,089	(24.2)	1,300	(11.7)	9,789	(88.3)	
Patient characteristics							
Age							
19–49	11,144	(24.4)	911	(8.2)	10,233	(91.8)	
50–59	11,924	(26.1)	1,092	(9.2)	10,832	(90.8)	<0.0001
60–69	9,472	(20.7)	920	(9.7)	8,552	(90.3)	
≥70	13,201	(28.9)	1,501	(11.4)	11,700	(88.6)	
Sex							
Male	21,885	(47.8)	2,319	(10.6)	19,566	(89.4)	<0.0001
Female	23,856	(52.2)	2,105	(8.8)	21,751	(91.2)	
Social security							
Health insurance	42,972	(93.9)	4,030	(9.4)	38,942	(90.6)	<0.0001
Medical aid	2,769	(6.1)	394	(14.2)	2,375	(85.8)	
Medical subject							
Neurosurgery	44,151	(96.5)	4,324	(9.8)	39,827	(90.2)	
Neurology	204	(0.4)	18	(8.8)	186	(91.2)	<0.0001
Others	1,386	(3.0)	82	(5.9)	1,304	(94.1)	
CT							
0	198	(0.4)	23	(11.6)	175	(88.4)	
1–4	20,012	(43.8)	2,755	(13.8)	17,257	(86.2)	<0.0001
≥5	25,531	(55.8)	1,646	(6.4)	23,885	(93.6)	
MRI							
0	35,813	(78.3)	4,046	(11.3)	31,767	(88.7)	
1	3,705	(8.1)	156	(4.2)	3,549	(95.8)	<0.0001
≥2	6,223	(13.6)	222	(3.6)	6,001	(96.4)	
ICU, days							
0	6,564	(14.4)	139	(2.1)	6,425	(97.9)	<0.0001
1–12	19,239	(42.1)	2,673	(13.9)	16,566	(86.1)	
≥13	19,938	(43.6)	1,612	(8.1)	18,326	(91.9)	
Route of hospitalization							
Emergency	35,526	(77.7)	3,594	(10.1)	31,932	(89.9)	<0.0001
Outpatient	10,215	(22.3)	830	(8.1)	9,385	(91.9)	
Medical expenditure (per case)							
Terilte 1 (low)	15,357	(33.6)	1,996	(13.0)	13,361	(87.0)	
Tertile 2	15,293	(33.4)	1,363	(8.9)	13,930	(91.1)	<0.0001
Tertile 3 (high)	15,091	(33.0)	1,065	(7.1)	14,026	(92.9)	
CCI							
0	25,083	(54.8)	2,253	(9.0)	22,830	(91.0)	
1	18,253	(39.9)	1,962	(10.7)	16,291	(89.3)	<0.0001
≥2	2,405	(5.3)	209	(8.7)	2,196	(91.3)	

Table 1 (continued)

Variables	Total		Mortality within 30 days				*p* value
			death		alive		
	N	%	*N*	%	*N*	%	
Total (*N* = 45,741)	45,741	(100.0)	4,424	(9.7)	41,317	(90.3)	
Year							
2013	9,858	(21.6)	1,080	(11.0)	8,778	(89.0)	<0.0001
2014	11,782	(25.8)	1,161	(9.9)	10,621	(90.1)	
2015	11,966	(26.2)	1,074	(9.0)	10,892	(91.0)	
2016	12,135	(26.5)	1,109	(9.1)	11,026	(90.9)	

CCI, Charlson comorbidity index; MRI, magnetic resonance imaging; ICU, intensive care unit; CT, computerized tomography.

Methods

Data and Study Participants

Data for this study were taken for the period 2013–2016 from the HIRA claims database, which contains medical billing data of the entire South Korean population, including identifiers for the prescriber, the number of outpatient visits, number of days of hospitalization, number of prescriptions, and prescription details [12]. This study was reviewed and approved by the HIRA committee (2020-085-001) and adheres to the tenets of the Declaration of Helsinki. As all HIRA data are fully anonymized, ethical approval was not required for this secondary analysis study.

To ensure homogeneity, data of patients hospitalized due to a diagnosis of hemorrhagic stroke (ICD-10: I61, I62) and who underwent surgery between 2013 and 2016 were included in this study. This included patients who underwent (1) burr hole or trephination, (2) craniotomy or craniectomy, (3) craniotomy for evacuation of hematoma, (4) cerebral aneurysm, (5) operation of cerebral arteriovenous, (6) intracerebral vascular anastomosis, (7) shunt operation or bypass operation, (8) repair of cerebrospinal fluid leakage, (9) endoscopic brain surgery, (10) central nervous system stereotactic operation, (11) operation of skull base, (12) percutaneous thrombus removal, and (13) embolization, which is the most common surgery conducted in South Korea for patients who had stroke. Moreover, we excluded information from individuals aged 1–18 years and data with missing information about hospital and patient characteristics. Eventually, data on 45,741 patients from 374 healthcare organizations were analyzed.

Variables

Stroke quality assessment was the main independent variable of this study; healthcare organizations were divided into those that did and did not conduct stroke quality assessments. To be qualified for the stroke quality assessment, tertiary and general hospital with 10 or more acute stroke admission to be assessed [6]. The healthcare organization which had less than 10 cases of acute stroke admission was not qualified to the stroke quality assessment. Moreover, clinics were not included due to lack of data.

Hospital characteristics included volume and location of hospital. The volume was calculated by the sum of the physician volume in each hospital. Each hospital's volume was then classified as low, medium, or high according to the tertile. The location of hospital was classified as urban (including capital area and metropolitan) or rural. Patients' characteristics included age (under 50, 50–59, 60–69, and over 70), sex (male and, female), social security (health insurance and medical aid), medical subject (neurosurgery, neurology, and others), computerized tomography (0, 1–4, and over 5 times), magnetic resonance imaging (0, 1, and over 2 times), days in the intensive care unit (0, 1–12, and over 13 days), route of hospitalization (emergency and outpatient), medical expenditure per case (low, medium, or high according to tertile), Charlson comorbidity index (CCI; 0, 1, and over 2), and year (2013–2016).

The social security system in South Korea, the National Health Insurance System, covers the entire population residing within the territory of Korea, mainly financing contributions from insured and subsidies from the government, except for beneficiaries of medical aid [13]. Medical aid is part of the Korean public assistance system for people who were unable to pay for their own healthcare coverage, financed by both central and local governments [13]. Medical subject refers to the department type the patient visited according to the medical billing data. In the case of computerized tomography, magnetic resonance imaging, and intensive care unit, the classification was based on the median; these were categorized as 0 times (or days) and the remaining values were classified based on a criterion separated by the median. The CCI index was calculated by attaching weights and scoring comorbid conditions, with additional points for comorbidities that affect patients' health outcomes [14].

The dependent variable of this study was death within 30 days of the date of hospitalization for hemorrhagic stroke, which is a result indicator of stroke quality assessment. As this indicator is not included in the stroke quality assessment composite score yet, our study used death within 30 days of each hospitalization as an outcome to determine whether measurement actually affected this result indicator. Death was ascertained based on whether the hospital's reason for discharge was marked as dead. We identified each hospitalized patient's initial date of admission in the study period as the index date. If the date of death (discharge due to death) for each hospitalization was within 30 days from the index date, it was classified as mortality within 30 days. As the cause of mortality could not be ascertained from the data, a 30-day period was set to determine the outcome of the hemorrhagic stroke surgery.

Table 2. OR for 30-day mortality

Variables	Mortality within 30 days	
Hospital characteristics (374 healthcare organizations)		
Stroke quality assessment		
Yes (206 healthcare organizations)	1.00	
No (168 healthcare organizations)	1.53	(1.16–2.01)
Volume		
Tertile 1 (low; 314 healthcare organizations)	1.80	(1.39–2.34)
Tertile 2 (35 healthcare organizations)	1.13	(0.84–1.53)
Tertile 3 (high; 25 healthcare organizations)	1.00	
Region of hospital		
Urban area (227 healthcare organizations)	1.00	
Rural area (147 healthcare organizations)	1.29	(1.07–1.56)
Patient characteristics		
Age		
19–49	1.00	
50–59	1.11	(1.01–1.22)
60–69	1.31	(1.18–1.45)
≥70	1.59	(1.45–1.75)
Sex		
Male	1.29	(1.21–1.38)
Female	1.00	
Social security		
Health insurance	1.00	
Medical aid	1.38	(1.22–1.56)
Medical subject		
Neurosurgery	1.00	
Neurology	1.98	(1.16–3.39)
Others	0.80	(0.63–1.02)
CT		
0	1.00	
1–4	1.31	(0.82–2.11)
≥5	0.47	(0.29–0.76)
MRI		
0	1.00	
1	0.37	(0.31–0.44)
≥2	0.26	(0.22–0.30)
ICU, days		
0	1.00	
1–12	11.00	(9.14–13.25)
≥13	9.42	(7.70–11.51)
Route of hospitalization		
Emergency	1.95	(1.73–2.19)
Outpatient	1.00	
Medical expenditure (per case)		
Terilte 1 (low)	1.00	
Tertile 2	0.62	(0.57–0.67)
Tertile 3 (high)	0.64	(0.58–0.72)
CCI		
0	1.00	
1	1.35	(1.26–1.45)
≥2	0.96	(0.82–1.13)
Year		
2013	1.00	
2014	0.91	(0.83–1.00)
2015	0.84	(0.77–0.93)
2016	0.92	(0.83–1.01)

CCI, Charlson comorbidity index; OR, odds ratio; MRI, magnetic resonance imaging; ICU, intensive care unit; CT, computerized tomography.

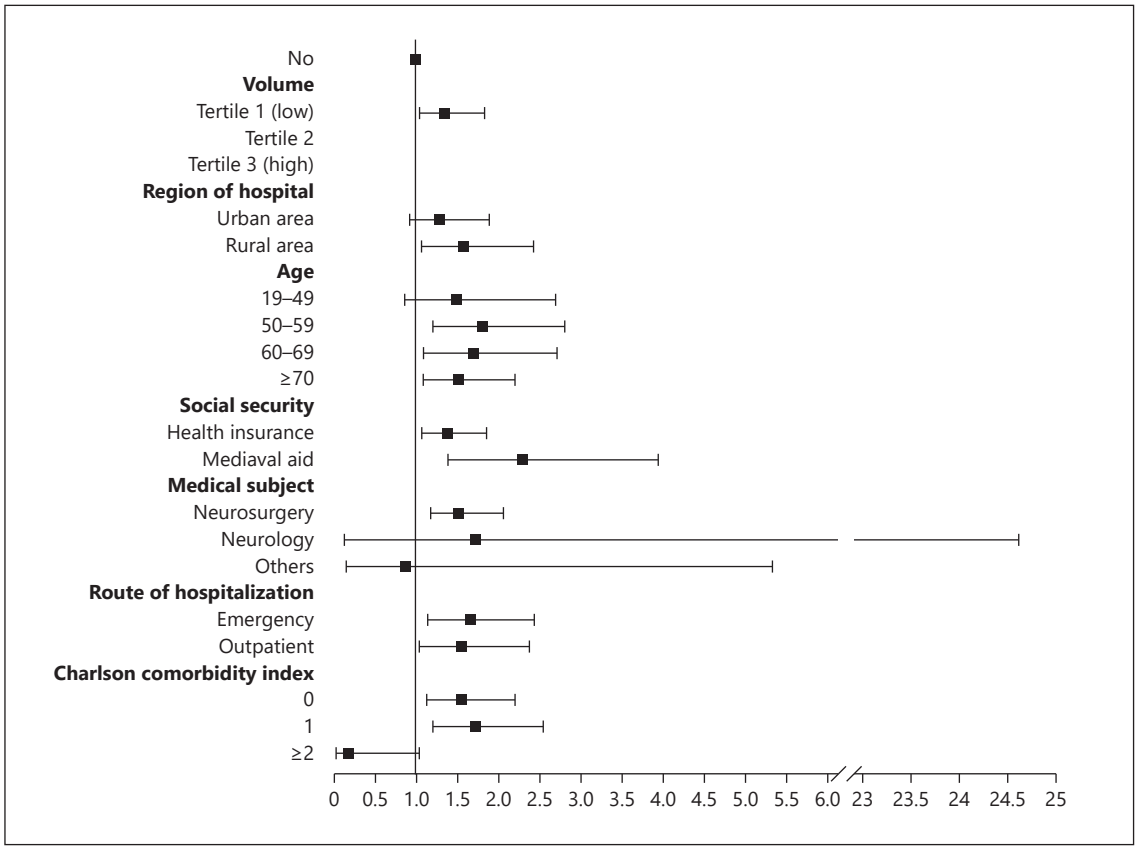

Fig. 1. Forest plots of subgroup analysis of the association between stroke quality assessment and 30-day mortality. Reference group is "No," which refers to those without stroke quality assessment. Adjusted for volume, regional hospital, age, sex, social security, type of department, CT, MRI, ICU, route of hospitalization, medical expenditure, CCI, year. CCI, Charlson comorbidity index; MRI, magnetic resonance imaging; ICU, intensive care unit; CT, computerized tomography.

Statistical Analysis

χ^2 tests were conducted to investigate the general characteristics of the study population. These analyses were performed for hospital- and patient-level variables. Hierarchical logistic regression analysis using multilevel models with the generalized linear mixed model procedure including hospital- and patient-level variables were performed to examine the association between stroke quality assessment and mortality within 30 days, after accounting for potential confounding variables. The results are reported as an odds ratio (OR) with a 95% confidence interval (CI). Differences were considered statistically significant with a $p < 0.05$. All data analyses were conducted using SAS (version 9.4; SAS Institute Inc., Cary, NC, USA).

Results

Table 1 presents the general characteristics of the study population. Among the 45,741 participants, 4,424 (9.7%) died within 30 days of hospitalization. Of the 374 healthcare organizations, 206 (96.7%) conducted stroke quality assessments. A total of 25 out of 374 organizations were classified as high-volume healthcare organizations. The association between stroke quality assessments and 30-day mortality was statistically significant.

Table 2 reports the OR for 30-day mortality. Compared to those who conducted stroke quality assessment, those who did not had higher risk of mortality (adjusted OR = 1.53, 95% CI = 1.16–2.01). As the volume decreased, the risk of mortality increased (tertile 1 [low], adjusted OR = 1.80, 95% CI = 1.39–2.34; tertile 2, adjusted OR = 1.13, 95% CI = 0.84–1.53). Hospitals located in rural areas had a higher risk of mortality than those in urban areas (adjusted OR = 1.29, 95% CI = 1.07–1.56). Patients who had medical aid had a higher risk of 30-day mortality (adjusted OR = 1.38, 95% CI = 1.22–1.56). Regarding the route of hospitalization, patients in emergency had a

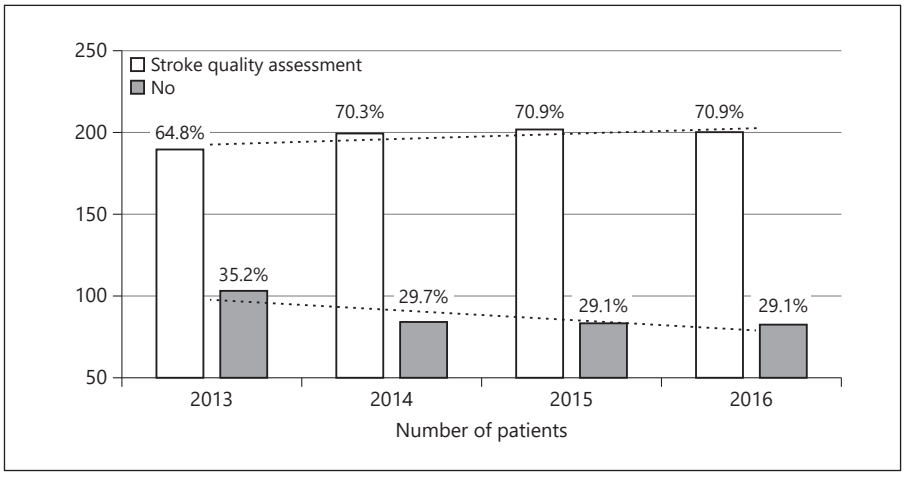

Fig. 2. Number of hospitals according to stroke quality assessments.

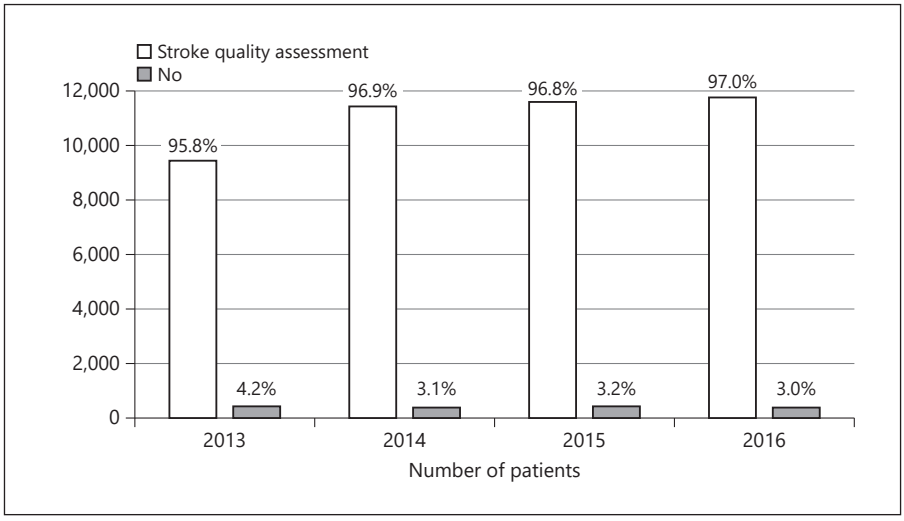

Fig. 3. Number of patients according to stroke quality assessments.

higher risk of mortality than the outpatients (adjusted OR = 1.95, 95% CI = 1.73–2.19).

Figure 1 shows the results of subgroup analysis of the association between stroke quality assessment and 30-day mortality, stratified by volume, location of hospital, age, social security, medical subject, route of hospitalization, and CCI. With regard to healthcare organizations that had the lowest volume, those that did not conduct stroke quality assessments had a higher risk of mortality than those that conducted assessments (tertile 1 [low], adjusted OR = 1.38, 95% CI = 1.04–1.84). Healthcare organizations located in rural areas that did not conduct stroke quality assessments had a higher risk of mortality than those that did (adjusted OR = 1.61, 95% CI = 1.06–2.43). Compared to those that did conduct stroke quality assessments, those that did not had a higher risk of mortality when patients were in emergency (adjusted OR = 1.67, 95% CI = 1.14–2.43).

Figure 2 shows the number of hospitals according to whether stroke quality assessments are conducted. The number of hospitals that conducted stroke quality assessments increased over the years. In 2013, 64.8% of hospitals conducted stroke quality assessment, which increased to 70.9% in 2016. Figure 3 shows the number of patients according to whether stroke quality assessments are conducted. Moreover, the patients tend to move to healthcare organizations with stroke quality assessments. In 2013, 4.2% of the patients visited hospitals without stroke quality assessment, which decreased to 3.0% in 2016.

Discussion

Stroke is a rapidly growing public health problem and one of the most common causes of death. Therefore, minimizing the burden of and managing strokes are considered a public health priority. Although stroke quality assessments have been implemented, some healthcare organizations are not subject to the assessment. Our results reveal that those who did not have stroke quality assessments had a higher risk of mortality, especially the low-volume healthcare organizations. To reveal the importance of expanding the target of stroke quality assessments to include all healthcare organizations, we analyzed the association between stroke quality assessments and 30-day mortality.

Hospital mortality is highly associated with the case volume. Institutions with higher volume or more experience are likely to have a system or established protocols regarding high-risk surgical procedures and the postoperative management [15]. Previous studies have also shown that the risk of mortality doubled for patients operated on by lower volume surgeons and centers compared to the high-volume surgeons and organizations [15, 16]. Therefore, prioritizing institutions that have lower volumes or low experience is important. Our study also found that among healthcare organizations that had the lowest volume, those that did not conduct stroke quality assessment had a higher risk of mortality than those that did. Healthcare management systems of organizations without proper assessment may be poor, which will consequently have a negative effect by reducing the amount of care; thus, to avoid this, stroke care quality assessments should be ensured.

Moreover, the quality of hospitals, indicated by hospital resources, staff, and protocols, may be strongly associated with mortality. Most of the hospitals with above 1,000 beds are educational and tertiary hospitals with sufficient medical staff and surgeons, who are highly experienced and subspecialized with frequent operations [17]. Especially in the case of complex surgical procedures that require expensive medical equipment and specialized skills, the hospitals that frequently perform such procedures are associated with lower costs and lower mortality [18]. The mortality might be lower as hospital resources and protocols were already well established in these hospitals, and these were the healthcare organizations being targeted for quality assessments. Therefore, more quality assessments should be conducted in small healthcare organizations, where quality control is more difficult due to lack of resources.

Mortality is strongly associated with access to medical care for complications and the residential area [19]. Low per capita income in the country of residence is related to unintentional injury rates, which are higher in rural areas than in urban areas [20]. This shows that mortality is associated with geographic areas [21]. Our study revealed that among healthcare organizations located in rural areas, those without assessment had a higher risk of mortality. Therefore, prioritizing those located in rural areas is necessary.

Moreover, emergency patients should be managed on priority as they have a higher risk of mortality [22]. Our study reveals that healthcare organizations without stroke quality assessments exhibit a higher risk of mortality among emergency patients than those with quality assessments. Thus, the quality of the healthcare organization could influence emergency mortality [23]. Therefore, to lower the risk of emergency mortality, the target of stroke quality assessments should be expanded.

The current study has several limitations. First, due to lack of data, we could not include data from clinics. Second, as we used claims data, we could not determine the specific reasons for the deaths. Therefore, we could not ascertain whether they were due to strokes. However, as we only targeted hemorrhagic stroke patients who had undergone surgery, death within 30 days from hospitalization may have been caused by the stroke. Furthermore, information on quality of life of family members or after their discharge could not be included as we used claims data. Moreover, the factors which could affect the severity of stroke, such as hematoma volume, were also not included. To ensure homogeneity, we only included patients who suffered hemorrhagic stroke and underwent surgery. Further research is needed to evaluate the association after adjusting for the severity of stroke. Lastly, as claims data are generated to reimburse healthcare services eligible for coverage, services that are not covered under the system are absent in the data [24].

Despite these limitations, our study has some strengths as well. As the HIRA database contains 98% of Korea's health insurance claim data, our study is representative of the entire Korean population [25]. Therefore, this could serve as a foundation for health-related policies or programs. Moreover, as there is a lack of studies on stroke quality assessments, it is essential to highlight its effectiveness, compelling policymakers, and health system leaders to devise effective strategies and policies.

The current study identified a significant relationship between stroke quality assessment and mortality within 30 days of hospitalization among South Korean adults who underwent hemorrhagic stroke surgery. Our finding suggests that compared to those with stroke quality assessment, those without had a higher risk of mortality. Among low-volume healthcare organizations, those that without stroke

quality assessments had a higher risk of mortality than those with assessments. Furthermore, there remain few healthcare organizations that did not conduct such assessments, which had a high mortality risk. Therefore, our study proposes future interventions to minimize mortality and provide evidence for policymakers and health system leaders to expand the scope of stroke quality assessment to include those who are currently without quality assessment, managing them in local units or over longer assessment cycles.

Acknowledgement

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Statement of Ethics

This study was based on routinely collected administrative and claims data. All individuals provided written informed consent at the time of data collection by the HIRA. This study was reviewed and approved by the HIRA committee (2020-085-001) and adheres to the tenets of the Declaration of Helsinki. As all HIRA data were fully anonymized, ethical approval was not required for this study using secondary data.

Conflict of Interest Statement

The authors have no conflict of interest to declare.

Funding Sources

No funding was received for this study.

Author Contributions

Mi-Na Lee conceived and designed the study. Wonjeong Jeong conducted the formal analysis and developed the methodology. Mi-Na Lee and Wonjeong Jeong wrote the initial drafts. Sung-In Jang and Sohee Park helped draft the manuscript. Eun-Cheol Park is the corresponding author of this work and supervised work on the entire manuscript. All the authors read and approved the final manuscript.

Data Availability Statement

The datasets generated and/or analyzed during the current study are not publicly available because the HIRA of Korea requests all related researchers to pledge not to review, share, or release the database. It is possible for other researchers to require access to the dataset directly from the HIRA.

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