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ORIGINAL RESEARCH

Effects of Transferring to the Rehabilitation Ward on Long-Term Mortality Rate of First-Time Stroke Survivors: A Population-Based Study

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Abstract

Objective: To assess the long-term health outcomes of acute stroke survivors transferred to the rehabilitation ward.

Design: Long-term mortality rates of first-time stroke survivors during hospitalization were compared among the following sets of patients: patients transferred to the rehabilitation ward, patients receiving rehabilitation without being transferred to the rehabilitation ward, and patients receiving no rehabilitation.

Setting: Retrospective cohort study.

Participants: Patients (N = 11,419) with stroke from 2005 to 2008 were initially assessed for eligibility. After propensity score matching, 390 first-time stroke survivors were included.

Interventions: None.

Main Outcome Measure: Cox proportional hazards regression model was used to assess differences in 5-year poststroke mortality rates.

Results: Based on adjusted hazard ratios (HRs), the patients receiving rehabilitation without being transferred to the rehabilitation ward (adjusted HR, 2.20; 95% confidence interval [CI], 1.36−3.57) and patients receiving no rehabilitation (adjusted HR, 4.00; 95% CI, 2.55−6.27) had significantly higher mortality risk than the patients transferred to the rehabilitation ward. Mortality rate of the stroke survivors was affected by age ≥65 years (compared with age <45y; adjusted HR, 3.62), being a man (adjusted HR, 1.49), having ischemic stroke (adjusted HR, 1.55), stroke severity (Stroke Severity Index [SSI] score≥20, compared with SSI score<10; adjusted HR, 2.68), and comorbidity (Charlson-Deyo Comorbidity Index [CCI] score≥3, compared with CCI score = 0; adjusted HR, 4.23).

Conclusions: First-time stroke survivors transferred to the rehabilitation ward had a 5-year mortality rate 2.2 times lower than those who received rehabilitation without transfer to the rehabilitation ward and 4 times lower than those who received no rehabilitation.

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Stroke can cause disabilities[1] and increase social and family burden.[2] In Taiwan, the average annual incidence and prevalence rates of first-time stroke were 330 per 100,000 and 1642 per 100,000, respectively, in people age ≥36 years.[3,4] Regardless of its chronicity, poststroke rehabilitation generally produces the largest functional and motor improvements during the first year

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after stroke.[5] In Taiwan, it was estimated that 42.6% of patients with first-time stroke received rehabilitation during the first year after stroke.[6] Furthermore, the overall utilization of stroke rehabilitation services during hospitalizations was 34% among patients with stroke.[7]

The single-payer, government-based National Health Insurance (NHI) program was launched in Taiwan in 1995. This universal program covers all insured individuals and has enrolled >99% of all Taiwanese citizens and legal residents, with premiums generally ranging from 2% to 5% of the total household income.[8] In Taiwan, prescribing appropriate rehabilitation with uniform complexity by a physiatrist (or clinician) for hospitalized patients with first-time stroke is mainly based on whether a hospital can offer rehabilitation services and whether a patient has dysfunction in limb movements, speech, or swallowing. Patients with dysfunction in limb movements may be transferred to a rehabilitation ward if a hospital provides rehabilitation services and ward for subsequent stroke rehabilitation depending on physiatrist-patient (or family) agreement.

Rehabilitation for patients with acute stroke leads to a better outcome and does not increase in-hospital mortality.[9] Treatment and rehabilitation in a stroke unit have reduced the relative mortality risk within 5 years poststroke.[10] Stroke rehabilitation initiated in the first 3 months poststroke admission may significantly reduce the 10-year mortality risk poststroke.[11] Rehabilitation or transfer to rehabilitation services soon after a stroke results in greater functional improvements.[12] To our knowledge, no study has addressed the long-term outcomes of transferring first-time stroke survivors to the rehabilitation ward during hospitalization.

This study assessed long-term differences in follow-up outcomes (all-cause mortality rate) among stroke survivors transferred to the rehabilitation ward during hospitalization, those who received rehabilitation without transfer to the rehabilitation ward, and those who received no rehabilitation during first-time stroke hospitalization. We hypothesized that differences in long-term health outcomes exist among the 3 groups. Using a nationwide database, we conducted a 5-year, retrospective, follow-up, cohort study to examine the differences in all-cause mortality rates among the 3 groups.

Methods

Source of data

In Taiwan, the National Health Insurance Research Database (NHIRD) comprises de-identified personal data that are available for research purposes. This database includes important information, including beneficiaries; *International Classification of Diseases—9th Revision—Clinical Modifications* (ICD-9-CM) diagnostic and procedure codes; catastrophic illness and medical service registries; prescription orders, details, and expenditures at contracted pharmacies; and inpatient and outpatient claims and copayments.

The study protocol was approved by the Institutional Review Board for Human Studies of the Chang Gung Memorial Hospital (approval no. 104-7183B). Data were obtained from the Longitudinal Health Insurance Database 2005 of the NHIRD. The Longitudinal Health Insurance Database 2005 comprises medical claims of 1 million beneficiaries randomly selected from all Taiwanese insured in the year 2005, with age and sex distributions being almost identical to the general population. Longitudinal data (1997—2013), including inpatient claims and prescription order details by admission, outpatient and emergency department claims and prescription order details, and registry for beneficiaries, were retrieved.

List of abbreviations:

CCI	**Charlson-Deyo Comorbidity Index**
CI	**confidence interval**
HR	**hazard ratio**
ICD-9-CM	***International Classification of Diseases—9th Revision—Clinical Modifications***
NHI	**National Health Insurance**
NHIRD	**National Health Insurance Research Database**
SSI	**Stroke Severity Index**

Participants

Subjects with inpatient claims including patient admission data for primary or secondary stroke diagnosis (ICD-9-CM codes 430—434 and 436—437) were enrolled from 2005 to 2008. Subarachnoid and intracerebral hemorrhage was categorized as ICD-9-CM 430 and 431 to 432, respectively; cerebral infarction was categorized as ICD-9-CM 433 to 434. Other unspecified cerebrovascular diseases were categorized as ICD-9-CM 436 to 437. Subjects with ICD-9-CM codes 430 to 434, 436 to 437, and 438 (late effects of cerebrovascular disease) for inpatient, outpatient, and emergency department claims from 1997 to 2004, respectively, were excluded because they were not considered patients with first-time stroke.

The index date was defined as the date of first hospital admission because of first-time stroke. Some patients with first-time stroke were transferred from one hospital to another for further care during the acute stage; first-time stroke hospitalization was defined as hospitalization at the first hospital and combined hospitalization at both the first and second hospitals, if the second hospitalization occurred within 3 days after the index date and had the same primary or secondary stroke diagnosis as the first hospital. Subjects with no definite date of discharge and those with mortality (discharge status being death) during first-time stroke hospitalization were excluded. Subjects who withdrew from NHI within 5 years after the index date were excluded.

In this study, the patients transferred to the rehabilitation ward group comprised patients who were transferred to the rehabilitation ward and had rehabilitation therapy orders on the claims of first-time stroke hospitalization. We assumed that all first-time stroke survivors who were transferred to the rehabilitation ward after care in an acute ward received a period of rehabilitation and were then discharged from the rehabilitation ward. Discharge code 14 (rehabilitation department) was used to determine whether a patient was transferred to the rehabilitation ward. The patients receiving rehabilitation without being transferred to the rehabilitation ward group comprised patients who had rehabilitation therapy orders on claims of first-time stroke hospitalization, without the discharge code 14. The patients receiving no rehabilitation group comprised patients with no rehabilitation therapy orders on claims of first-time stroke hospitalization. Rehabilitation therapy orders included claims for physical, occupational, and speech therapy or a combination thereof. Claims for splint orders were not included in the rehabilitation therapy orders. Propensity score matching is a method of estimating the causal effect in observational studies when random allocation is not possible.[13]

Based on the characteristics of patients, patients in the patients transferred to the rehabilitation ward group, patients receiving no rehabilitation group, and patients receiving rehabilitation without being transferred to the rehabilitation ward group with similar characteristics were randomly selected according to propensity score matching at a 1:1 case/control ratio. Collectively, 390 subjects were included (patients receiving no rehabilitation: n = 130; patients receiving rehabilitation without being transferred to the rehabilitation ward: n = 130; and patients transferred to the rehabilitation ward: n = 130) (fig 1).

Characteristics of the participants

Age (<45, 45−64, and ≥65y), sex (men and women), stroke type (ischemic, hemorrhagic, and unspecific), insured amount (<$528 and ≥$528) per month, residential area of patients (7 urbanization levels),[14] length of stay for first-time stroke (1−14, 15−30, and >30d), Stroke Severity Index (SSI)[15] score (<10, 10−19, and ≥20), and Charlson-Deyo Comorbidity Index (CCI)[16,17] score (0, 1−2, and ≥3) were recorded. Values of $528 represented monthly salaries at tier 1 according to the 38-tier insured amount designed by the NHI. Length of stay for first-time stroke was defined as the total days of first-time stroke hospitalization. The total days included days spent in acute and rehabilitation wards (if the stroke survivors transferred to a rehabilitation ward). The SSI, which highly correlates with the National Institutes of Health Stroke Scale (.743 correlation coefficient),[15] comprises 7 predictive features (airway suction, bacterial sensitivity test, general ward stay, intensive care unit stay, nasogastric intubation, osmotherapy, and urinary catheterization) for measuring stroke severity. Information on these predictive features could be obtained from the NHIRD. The SSI score was used to examine stroke severity in the study. The CCI score was used as a weighted-summary measure of clinically important concomitant diseases adopted from the ICD-9-CM codes in inpatient claims of first-time stroke hospitalization. The CCI score was expressed as an integer. ICD-9-CM codes excluding cerebrovascular disease and hemiplegia were used for CCI scoring.

Definition of endpoint and mortality

All study subjects were followed from the index date to the endpoint. The endpoint was defined as 5 years after the index date or the date of all-cause mortality, whichever came first. All-cause mortality was defined according to a subject's status as death in the NHIRD.

Statistical analyses

SAS Studio 3.4[a] was used for data retrieval, compilation, and statistical analyses. Univariate associations between characteristics, including age, sex, insured amount, urbanization residency level, type of stroke, length of stay for first-time stroke, SSI score, and CCI score, were assessed using chi-square tests. Setting a medium effect size of $r = .30$ and the sample size of 390 achieved a power of .99. A Cox proportional hazards regression model[18] was adjusted for variables to assess the effect of patients transferred to the rehabilitation ward, patients receiving rehabilitation without being transferred to the rehabilitation ward, and patients receiving no rehabilitation groups on mortality risk. A hazard ratio (HR) was used to define the ratio of the hazard rates corresponding to the mortality described by 2 levels of an explanatory variable. Mortality rate was calculated by dividing the number of mortality cases by the number of person-years of follow-up.[19] The life table method was used to calculate the survival rates of the 3 groups. Five-year survival rates were also plotted using the Kaplan-Meier method. A log-rank test was used to test the differences between pairs of groups. $P<.05$ was considered statistically significant.

Results

Table 1 shows the individual characteristics of the study subjects. Table 2 shows the survival rates of patients transferred to the rehabilitation ward, patients receiving rehabilitation without being transferred to the rehabilitation ward, and patients receiving no rehabilitation during the 5-year follow-up. The 5-year survival rates were 82.3% (patients transferred to the rehabilitation ward), 73.1% (patients receiving rehabilitation without being transferred to the rehabilitation ward), and 52.3% (patients receiving no rehabilitation). The Kaplan-Meier survival curves showed significant differences in all subjects between patients transferred to the rehabilitation ward and patients receiving no rehabilitation ($P<.001$) and patients receiving rehabilitation without being transferred to the rehabilitation ward and patients receiving no rehabilitation ($P<.001$), with a marginally significant difference between patients transferred to the rehabilitation ward and patients receiving rehabilitation without being transferred to the rehabilitation ward ($P = .063$) (fig 2).

Table 3 shows the HR of mortality for each group and variables. The patients receiving rehabilitation without being transferred to the rehabilitation ward (adjusted HR, 2.20; 95% confidence interval [CI], 1.36−3.57; $P<.01$) and patients receiving no rehabilitation (adjusted HR, 4.00; 95% CI, 2.55−6.27; $P<.01$) had higher mortality rates than the patients transferred to the rehabilitation ward. Patients age ≥65 years (adjusted HR, 3.62; 95% CI, 1.79−7.32) were at a higher risk for death than those age <45 years ($P<.01$). Men had a higher mortality risk (adjusted HR, 1.49; 95% CI, 1.04−2.14; $P<.05$) than women. Patients with ischemic stroke had a higher mortality risk (adjusted HR, 1.55; 95% CI, 1.05−2.29; $P<.05$) than patients with hemorrhagic stroke. Patients with an SSI score of 10 to 19 (adjusted HR, 2.73; 95% CI, 1.60−4.66) and ≥20 (adjusted HR, 2.68; 95% CI, 1.43−5.02) had a higher mortality risk than those with an SSI score of <10 ($P<.01$). Patients with a CCI score of 1 to 2 (adjusted HR, 1.61; 95% CI, 1.12−2.32; $P<.05$) and ≥3 (adjusted HR, 4.23; 95% CI, 2.09−8.58; $P<.01$) had a higher mortality risk than those with a CCI score of 0.

Discussion

To our knowledge this study is the first to compare nationwide, long-term mortality of patients with first-time stroke, who were divided into 3 groups: patients transferred to the rehabilitation ward, patients receiving rehabilitation without being transferred to the rehabilitation ward, and patients receiving no rehabilitation. This study demonstrated that stroke survivors transferred to the rehabilitation ward and those receiving rehabilitation without being transferred to a rehabilitation ward had better 5-year outcomes with a lower mortality rate than those receiving no rehabilitation during first-time stroke hospitalization. In Taiwan, Hu et al[20] showed a significant inverse relation between the volume of inpatient rehabilitation therapy and mortality in patients with

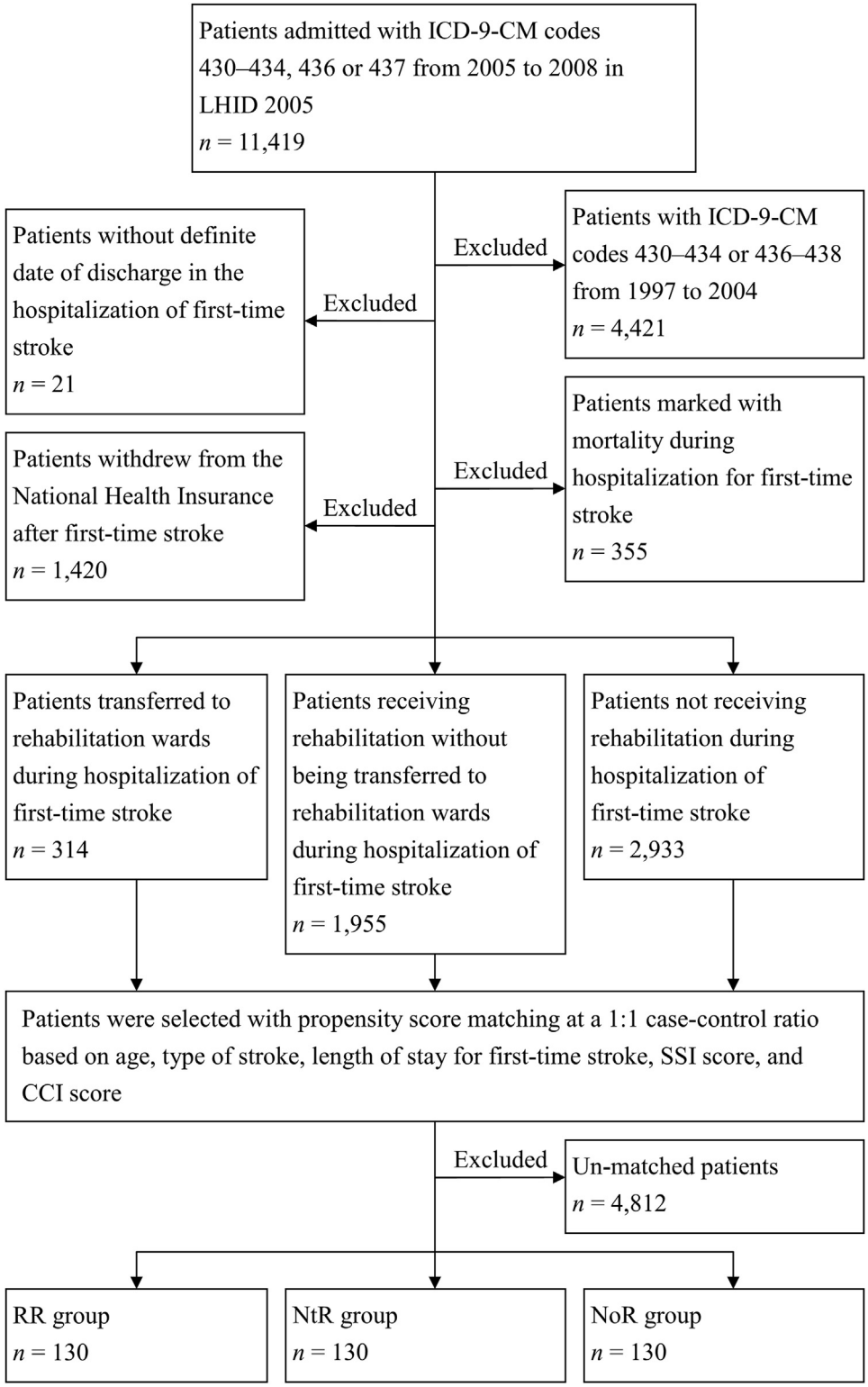

Fig 1 Flowchart of study subject selection. Abbreviations: LHID, Longitudinal Health Insurance Database; NoR, patients receiving no rehabilitation during first-time stroke hospitalization; NtR, patients receiving rehabilitation without being transferred to a rehabilitation ward during first-time stroke hospitalization; RR, patients transferred to a rehabilitation ward during first-time stroke hospitalization.

ischemic stroke. These results are consistent with the difference in all-cause mortality between the patients transferred to the rehabilitation ward and the patients receiving no rehabilitation, and between the patients receiving rehabilitation without being transferred to the rehabilitation ward and the patients receiving no rehabilitation for our study because the patients transferred to the rehabilitation ward and patients receiving rehabilitation without being transferred to the rehabilitation ward received rehabilitation

Table 1 Individual characteristics of the stroke survivors

Characteristics	RR Group (n=130)	NtR Group (n=130)	NoR Group (n=130)	*P*
Age, y				.983
<45	19 (14.6)	21 (16.2)	22 (16.9)	
45–64	49 (37.7)	49 (37.7)	46 (35.4)	
≥65	62 (47.7)	60 (46.1)	62 (47.7)	
Sex				.160
Women	42 (32.3)	50 (38.5)	57 (43.9)	
Men	88 (67.7)	80 (61.5)	73 (56.1)	
Insured amount per month				.094
<$528	76 (58.5)	62 (47.7)	78 (60.0)	
≥$528	54 (41.5)	68 (52.3)	52 (40.0)	
Urbanization residency level				.876
1 (most urbanized)	31 (23.9)	32 (24.6)	40 (30.8)	
2	41 (31.5)	39 (30.0)	39 (30.0)	
3	23 (17.7)	25 (19.2)	21 (16.1)	
4	24 (18.5)	19 (14.6)	17 (13.1)	
5	3 (2.3)	5 (3.9)	3 (2.3)	
6	2 (1.5)	6 (4.6)	6 (4.6)	
7 (least urbanized)	6 (4.6)	4 (3.1)	4 (3.1)	
Type of stroke				.865
Hemorrhagic	56 (43.1)	57 (43.9)	59 (45.4)	
Ischemic	72 (55.4)	71 (54.6)	67 (51.5)	
Unspecific	2 (1.5)	2 (1.5)	4 (3.1)	
Length of stay for first-time stroke, d				.999
1–14	18 (13.9)	18 (13.9)	18 (13.9)	
15–30	41 (31.5)	41 (31.5)	41 (31.5)	
>30	71 (54.6)	71 (54.6)	71 (54.6)	
SSI score				.996
<10	42 (32.3)	42 (32.3)	44 (33.8)	
10–19	62 (47.7)	62 (47.7)	59 (45.4)	
≥20	26 (20.0)	26 (20.0)	27 (20.8)	
CCI score				.999
0	83 (63.9)	81 (62.3)	82 (63.1)	
1–2	43 (33.0)	45 (34.6)	44 (33.8)	
≥3	4 (3.1)	4 (3.1)	4 (3.1)	

NOTE. Values are n (%) or as otherwise indicated.

Abbreviations: NoR, patients receiving no rehabilitation during first-time stroke hospitalization; NtR, patients receiving rehabilitation without being transferred to a rehabilitation ward during first-time stroke hospitalization; RR, patients transferred to a rehabilitation ward during first-time stroke hospitalization.

sessions, but the patients receiving no rehabilitation did not. Patients with early transfer to the rehabilitation ward/hospital showed better poststroke function,[12] which was a powerful predictor of long-term mortality in patients with stroke receiving inpatient rehabilitation.[21] According to the results of regression model, the patients receiving rehabilitation without being transferred to the rehabilitation ward had a higher mortality HR than the patients transferred to the rehabilitation ward. Performing postacute stroke rehabilitation in a rehabilitation ward could reduce the mortality rate in stroke survivors. The results provide evidence to support the provision of inpatient rehabilitation to all patients with stroke. However, not all hospitals under the current health insurance programs are able to provide inpatient rehabilitation for patients with postacute stroke because of limited staff, beds, and budget.

Previous studies have shown that stroke severity and comorbidities are associated with long-term mortality in patients with stroke. Stroke severity, including lower National Institutes of Health Stroke Scale scores (0–5)[22] and maximal Rankin scores (4 or 5),[23] could be used for predicting poststroke 1- and 5-year mortality, respectively. Increasing comorbidities were important predictors for poststroke 6-month[24] and 5-year[23] mortality. For patients with stroke receiving inpatient rehabilitation, comorbidities were also predictors for poststroke 5- to 6-year mortality.[21,25] According to our data, greater stroke severity (higher SSI scores) and more comorbidities (higher CCI scores) could also increase the mortality rate in these stroke survivors. Although stroke survivors transferred to the rehabilitation ward had stroke severity and comorbidity scores similar to those of survivors receiving rehabilitation without being transferred to the rehabilitation ward and survivors receiving no rehabilitation, survivors transferred to the rehabilitation ward had a lower mortality rate than that of survivors receiving rehabilitation without being transferred to the rehabilitation ward and survivors receiving no rehabilitation. This

Table 2 Survival rate and cumulative risk of death in the 3 groups

Years After Index Date	Number at Risk	Deaths	Cumulative Deaths	Survival Rate (%)	Risk of Death (%)	Cumulative Risk of Death (%)
RR group						
0—1	130	6	6	95.38	4.62	4.62
1—2	124	8	14	89.23	6.45	10.77
2—3	116	4	18	86.15	3.45	13.85
3—4	112	1	19	85.38	0.89	14.62
4—5	111	4	23	82.31	3.60	17.69
NtR group						
0—1	130	16	16	87.69	12.31	12.31
1—2	114	4	20	84.62	3.51	15.38
2—3	110	5	25	80.77	4.55	19.23
3—4	105	6	31	76.15	5.71	23.85
4—5	99	4	35	73.08	4.04	26.92
NoR group						
0—1	130	25	25	80.77	19.23	19.23
1—2	105	15	40	69.23	14.29	30.77
2—3	90	11	51	60.77	12.22	39.23
3—4	79	5	56	56.92	6.33	43.08
4—5	74	6	62	52.31	8.11	47.69

Abbreviations: NoR, patients receiving no rehabilitation during first-time stroke hospitalization; NtR, patients receiving rehabilitation without being transferred to a rehabilitation ward during first-time stroke hospitalization; RR, patients transferred to a rehabilitation ward during first-time stroke hospitalization.

was potentially attributed to a higher number of rehabilitation sessions, therefore preventing inactivity-related, life-threatening complications, including pneumonia.[20] In addition, if the patients with first-time stroke had stroke-associated complications, they could receive adequate care and patient/family education during their stay in the rehabilitation ward; this may reduce the subsequent long-term mortality rate after discharge. In the Kaplan-Meier survival curves (see fig 2), we observed that the obviously lower risk of death for the patients transferred to the rehabilitation ward compared with the patients receiving rehabilitation without being transferred to the rehabilitation ward and patients receiving no rehabilitation mainly occurred in the first of the 5 follow-up years. Perhaps, the lower mortality rate because of adequate care while staying in a rehabilitation ward during first-stroke hospitalization could last for 1 year but diminished in influence for 2 to 5 years after stroke.

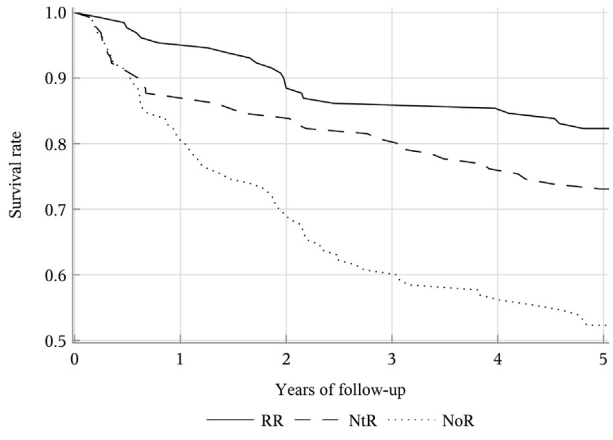

Fig 2 Comparison of the Kaplan-Meier survival curves of the 3 groups. RR group versus NtR group, P=.063; RR group versus NoR group, P<.001; and NtR group versus NoR group, P<.001. Abbreviations: NoR, patients receiving no rehabilitation during first-time stroke hospitalization; NtR, patients receiving rehabilitation without being transferred to a rehabilitation ward during first-time stroke hospitalization; RR, patients transferred to a rehabilitation ward during first-time stroke hospitalization.

Some previous studies have reported the mortality rate of stroke survivors receiving inpatient rehabilitation. Mutai et al[26] included 252 stroke survivors admitted to the rehabilitation ward and found that the 3-year cumulative mortality rate was 19.4%. Hanger et al[27] followed 141 patients who were discharged from a stroke rehabilitation unit and found that the 5-year mortality rate was 55% (78/141). De Wit et al[25] recruited 532 patients with first-time stroke from 4 European rehabilitation centers and found that the 5-year cumulative risk of death after inpatient stroke rehabilitation was 29.12%. Scrutinio et al[21] enrolled patients admitted for stroke rehabilitation within 90 days of stroke onset and found that 36.9% (253/686) of patients died during the median follow-up period of 6.17 years. The cumulative mortality rate of patients transferred to the rehabilitation ward of our study was similar or better than that of the aforementioned studies. Differences in study design, health care systems, and rehabilitation interventions may account for different results in various studies.

Age was a predictor for poststroke long-term (5—6y) mortality in patients with stroke[23] and in patients with stroke receiving rehabilitation.[21,25] Data showed that the HR of mortality increased for age ≥65 years compared with age <45 years. Apparently, age posed a greater effect on the mortality rate, particularly on geriatric patients with stroke than young patients with stroke.

One review[28] reported that women had a higher 30-day stroke mortality rate than men. A study by Bravata et al[29] showed that being of man is a predictor of 6-month mortality among patients with ischemic stroke. A prospective study by Ray et al[30] showed that women had a higher cumulative mortality rate than men 7 days after stroke, albeit with a lower cumulative mortality rate 7 years after stroke. Our study found that in stroke survivors, men had a higher long-term mortality rate than women. Although the

Table 3 HR of mortality in relation to selected variables

Variables	Death Rate (Per 1000 Person-years)	Unadjusted		Adjusted*	
		HR	95% CI	HR	95% CI
Group					
RR	37.2	1.00	NA	1.00	NA
NtR	56.9	1.56	0.99–2.47	2.20†	1.36–3.57
NoR	106.5	2.79†	1.82–4.28	4.00†	2.55–6.27
Age, y					
<45	25.1	1.00	NA	1.00	NA
45–64	38.0	1.54	0.76–3.10	1.69	0.80–3.58
≥65	105.2	4.13†	2.15–7.91	3.62†	1.79–7.32
Sex					
Women	60.1	1.00	NA	1.00	NA
Men	65.6	1.08	0.77–1.52	1.49‡	1.04–2.14
Insured amount per month					
<$528	77.0	1.56‡	1.11–2.19	1.18	0.80–1.74
≥$528	48.6	1.00	NA	1.00	NA
Urbanization residency level					
1 (most urbanized)	70.3	1.00	NA	1.00	NA
2	63.4	0.91	0.59–1.40	1.13	0.72–1.77
3	49.4	0.72	0.43–1.22	0.97	0.56–1.68
4	72.5	1.04	0.63–1.73	1.19	0.69–2.04
5	41.1	0.61	0.19–1.97	0.83	0.25–2.79
6	47.6	0.69	0.25–1.93	0.88	0.30–2.57
7 (least urbanized)	90.9	1.24	0.55–2.76	2.07	0.88–4.88
Type of stroke					
Hemorrhagic	49.4	1.00	NA	1.00	NA
Ischemic	77.3	1.55‡	1.10–2.18	1.55‡	1.05–2.29
Unspecific	40.8	0.84	0.21–3.45	0.81	0.19–3.56
Length of stay for first-time stroke, d					
1–14	19.1	1.00	NA	1.00	NA
15–30	42.5	2.22	0.98–5.03	1.32	0.54–3.21
>30	92.8	4.76†	2.21–10.23	1.98	0.82–4.80
SSI score					
<10	27.1	1.00	NA	1.00	NA
10–19	89.2	3.24†	2.04–5.13	2.73†	1.60–4.66
≥20	76.9	2.81†	1.65–4.79	2.68†	1.43–5.02
CCI score					
0	43.2	1.00	NA	1.00	NA
1–2	96.2	2.16†	1.53–3.04	1.61‡	1.12–2.32
≥3	289.5	6.49†	3.41–12.34	4.23†	2.09–8.58

Abbreviations: CI, confidence interval; NA, not applicable; NoR, patients receiving no rehabilitation during first-time stroke hospitalization; NtR, patients receiving rehabilitation without being transferred to a rehabilitation ward during first-time stroke hospitalization; RR, patients transferred to a rehabilitation ward during first-time stroke hospitalization.

* Adjusted for age, sex, insured amount, urbanization residency level, type of stroke, length of stay for first-time stroke, SSI score, and CCI score.

† $P<.01$.

‡ $P<.05$.

ratio of men to women was not significantly different between the 3 groups, whether the ratio of men to women could be a confounding factor for the mortality rates between the 3 groups, especially for a small size, remains uncertain.

Our study showed that ischemic stroke survivors have a higher mortality rate than hemorrhagic stroke survivors. Rutten-Jacobs et al[31] showed that 30-day hemorrhagic stroke survivors (13.7%) had a lower cumulative 20-year risk for death than 30-day ischemic stroke survivors (26.8%). Our results corroborate the study by Rutten-Jacobs.[31] However, Collins et al[32] illustrated that patients with hemorrhagic stroke (18.8%) had a higher adjusted 30-day mortality rate than patients with ischemic stroke (7.4%). We think the discrepancy of the mortality rate in stroke type between the study by Collins and our study was because Collins enrolled patients with stroke since the time of stroke onset, whereas we enrolled stroke survivors.

Koifman et al[33] showed that patients with stroke or transient ischemic attack living in rural areas tended to have a higher 30-day mortality rate than patients living in urban areas. However, according to our data, urbanization or ruralization had no effect on the mortality rate of stroke survivors. It is worth considering whether stroke survivors living in the least urbanized areas have

higher long-term mortality rates than those living in the most urbanized areas; we also considered its possible dependence on the territory size and density of medical institutions, which could provide services for stroke survivors. Taiwan is spread across 36,000km^2 and has a high density of medical institutions, which may reduce the effects of urbanization differences or inconvenience of transportation for patients with stroke trying to access health care services.

The 12-month follow-up study by Pan et al[34] in China showed an odds ratio of the mortality rate of low-income patients with ischemic stroke (≤¥1000 per month) of 1.19. Our results were different from those of the study by Pan.[34] Differences in health care service systems may have resulted in different results. In Taiwan, medical fees include the sum of the NHI claims and copayments. NHI claims are the costs that the hospital asks the Bureau of NHI to pay, and the copayment is the cost that the patient is asked to pay. To lessen the economic burden of medical treatment, patients with low income are exempt from the medical copayment. Stroke survivors with low income are also exempt. Therefore, they could access adequate health care services after stroke, which would not increase the mortality rate.

Although functional status (Barthel Index)[25] scores or gain of functional status (FIM)[21] were also identified by other studies as predictors of long-term mortality rate of patients with stroke who received inpatient rehabilitation, in Taiwan, the functional status of each patient with stroke undergoing rehabilitation was recorded in each patient's medical charts. Unfortunately, these data were not included in the NHIRD. In other words, we could not collect data of functional status from the NHIRD for first-time stroke survivors to assess the functional status effect on the long-term mortality rate. Another interesting issue is that patients transferred to the rehabilitation ward had a lower mortality rate. However, it is unclear whether patients transferred to the rehabilitation ward had better functional status during the survival period than patients receiving rehabilitation without being transferred to the rehabilitation ward and patients receiving no rehabilitation. Further prospective studies should evaluate the initial and subsequent functional status after stroke to assess whether the functional status could affect the mortality rate and to compare long-term functional outcomes between different study groups.

Study limitations

Because of possible referral bias resulting from our study design, the mortality rate listed for the 3 groups may not represent the stroke survivor population mortality rates. Some variables could possibly affect the actual mortality rate for these populations. For example, before propensity score matching, the patients receiving no rehabilitation may have had less stroke severity; therefore, they showed shorter length of stay than the patients receiving rehabilitation without being transferred to the rehabilitation ward and patients transferred to the rehabilitation ward. The length of stay may also have been shorter for the patients receiving rehabilitation without being transferred to the rehabilitation ward than for the patients transferred to the rehabilitation ward because the hospital did not have a rehabilitation ward or no bed was available at that time.

Our study had some caveats, considering the retrospective database analysis. The diagnoses were sourced from the NHIRD based on ICD-9-CM codes. These diagnoses may be less accurate than those collected prospectively using standard procedures. We were unable to collect additional data regarding factors such as functional status, which could possibly affect the mortality rate. In the future, prospective studies focusing on collecting information on the diagnoses and potential factors of the mortality rate aimed toward addressing the gaps in this topic are warranted.

Conclusions

Among first-time stroke survivors, the 5-year mortality HR reported in this study indicates that subjects who underwent rehabilitation in the rehabilitation ward had 2.2 times lower mortality risk than those who received rehabilitation without transfer to the rehabilitation ward, and had 4 times lower mortality risk than those who did not receive rehabilitation. Many factors, including age ≥65 years, being of male sex, having ischemic stroke (compared with hemorrhagic stroke), having higher stroke severity, and having more comorbidities, may increase the mortality rates of these stroke survivors during the 5-year poststroke follow-up. The data reported in this study are crucial for policy-making and adjusting care for patients with acute, first-time stroke.

Supplier

a. SAS Studio 3.4; SAS Institute.

Keywords

Mortality; Rehabilitation; Stroke

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