

# BMJ Open Insurance status and 1-year outcomes of stroke and transient ischaemic attack: a registry-based cohort study in China

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## ABSTRACT

**Objective** Although more than 95% of the population is insured by urban or rural insurance programmes in China, little research has been done on insurance-related outcome disparities for patients with acute stroke and transient ischaemic attack (TIA). This study aimed to examine the relationship between insurance status and 1-year outcomes for patients with stroke and TIA.

**Methods** We abstracted 24 941 patients with acute stroke and TIA from the China National Stroke Registry II. Insurance status was categorised as Urban Basic Medical Insurance Scheme (UBMIS), New Rural Cooperative Medical Scheme (NRCMS) and self-payment. The relationship between insurance status and 1-year outcomes, including all-cause death, stroke recurrence and disability, was analysed using the shared frailty model in the Cox model or generalised estimating equation with consideration of the hospital's cluster effect.

**Results** About 50% of patients were covered by UBMIS, 41.2% by NRCMS and 8.9% by self-payment. Compared with patients covered by UBMIS, patients covered by NRCMS had a significantly higher risk of all-cause death (9.7% vs 8.6%, adjusted HR: 1.32 (95% CI 1.17 to 1.48),  $p < 0.001$ ), stroke recurrence (7.2% vs 6.5%, adjusted HR: 1.12 (95% CI 1.11 to 1.37),  $p < 0.001$ ) and disability (32.0% vs 26.3%, adjusted OR: 1.29 (95% CI 1.21 to 1.39),  $p < 0.001$ ). Compared with patients covered by UBMIS, self-payment patients had a similar risk of death and stroke recurrence but a higher risk of disability.

**Conclusions** Patients with stroke and TIA demonstrated differences in 1-year mortality, stroke recurrence and disability between urban and rural insurance groups in China.

## INTRODUCTION

Studies in the USA and Canada have suggested that insurance is an important independent indicator of health outcomes.<sup>1–3</sup> Since 1994, China has undertaken a series of healthcare insurance initiatives.<sup>4,5</sup> By 2011, 95% of the population was insured by the New Rural Cooperative Medical Scheme (NRCMS), Urban Resident Basic Medical Insurance (URBMI) or Urban Employee Basic Medical Insurance (UEBMI).<sup>4</sup> The target populations

## Strengths and limitations of this study

- We provide a large-scale, nationwide, prospective, registry project-based study to explore the association between insurance status and 1-year outcome for patients with stroke and transient ischaemic attack.
- High-quality data obtained through systematic and standardised approach and statistical methods considering the cluster effect of the hospital and competing risk of stroke were used to draw the conclusions.
- The sampling method we used did not strictly represent nationwide hospitals.
- One-year outcomes obtained by telephone follow-up were not an accurate measurement.
- Unmeasured factors including lifestyle issues or even ethnic/genetic variations may affect the results.

of NRCMS, URBMI and UEBMI are rural residents, urban residents and urban employees, respectively. Both inpatients and outpatients are covered by each insurance programme. Compared with NRCMS, the insurance premium and reimbursement rate are much higher for URBMI and UEBMI.<sup>4</sup> Although health insurance coverage can reduce the financial burden and improve health service utilisation,<sup>6</sup> different insurance programmes may have different effects on health outcomes due to different restrictions on access to healthcare. Some studies have suggested that better health insurance predicts more favourable stroke outcomes.<sup>7–9</sup> In China, some studies also suggested that urban health insurances are related to better hypertension management and less major adverse cardiovascular events. However, these studies were focused on cardiovascular diseases,<sup>10–12</sup> or limited only to prevalence or mortality of stroke,<sup>13,14</sup> or too early from the accomplishment of the series of healthcare insurance initiatives.<sup>14</sup>

Stroke is the second leading cause of death and a major cause of long-term disability worldwide.<sup>15 16</sup> China has experienced an increasing stroke burden over the last 30 years, especially in rural areas.<sup>17</sup> Stroke is the leading cause of death in rural areas and the third leading cause of death in urban cities in China.<sup>18</sup> In rural areas, the population is covered mainly by rural insurance groups. However, it is unclear whether insurance-related outcome disparities exist for patients with stroke and transient ischaemic attack (TIA) in China. Therefore, we examined the relationship between insurance status and 1-year outcomes for patients with stroke and TIA. Ischaemic and haemorrhagic types of stroke and TIA were also analysed to provide a comprehensive picture of cerebrovascular disease outcomes across different insurance groups.

## METHODS

### Study design of the China National Stroke Registry II

The design of the China National Stroke Registry II (CNSR II) study has been described previously.<sup>19 20</sup> Briefly, CNSR II is a nationwide, hospital-based, prospective cohort study initiated in 2012 by the Ministry of Health to assess stroke care delivery and 1-year outcomes to identify fields that need further improvement when compared with CNSR I in 2007. A total of 219 secondary or tertiary public hospitals were selected by the steering committee using the same criteria applied in CNSR I.<sup>21</sup> Each participant signed an informed consent before his/her participation in the study.

### Participant enrolment and study population

Patients were recruited consecutively from all 219 hospitals from June 2012 to January 2013. Inclusion criteria included (1)  $\geq 18$  years of age; (2) diagnosis within 7 days of the index event of acute ischaemic stroke, TIA, spontaneous intracerebral haemorrhage or subarachnoid haemorrhage confirmed by brain CT or MRI; (3) direct hospital admission from a physician's clinic or emergency department; and (4) written informed consent offered by the patient or his/her legally authorised representative.

### Data collection and abstraction

Trained research coordinators at each hospital checked the medical records daily to identify, obtain informed consent and recruit consecutive patients. Data on prestroke modified Rankin Scale<sup>22</sup> (mRS, with scores ranging from 0 to 6, with a score of 0 indicating no disability and higher scores indicating more severe disability) and National Institutes of Health Stroke Scale<sup>23</sup> (NIHSS, with scores ranging from 0 to 42, with higher scores indicating a more severe deficit) were obtained from interviews with patients or their legal representative. Other data extracted from the medical records included patient demographics, health insurance status, education level (classified into three levels: elementary or below ( $\leq 6$  years), middle school (7–9 years), and high school or above ( $\geq 10$  years)), household income (classified into two

categories based on per capita monthly income:  $\leq \text{¥}1000$  and  $> \text{¥}1000$ ), smoking, drinking, vascular risk factors, usage of medications, selected laboratory tests and discharge status. Vascular risk factors included history of stroke/TIA, hypertension, diabetes mellitus, dyslipidaemia, atrial fibrillation, coronary heart disease, myocardial infarction and peripheral vascular disease. They were defined as a medical chart-confirmed history, usage of corresponding medications before stroke onset, or a physician's diagnosis according to the findings of physical or auxiliary examinations during hospitalisation.

### Patient and public involvement

Patients and the public were not directly involved in the development of, recruitment to and conduct of the study. The results of the study will be disseminated to the patients and the public through social media.

### Insurance status

During the data collection stage, URBMI and UEBMI were categorised as Urban Basic Medical Insurance Scheme (UBMIS) in the case report form. Since only 77 (0.3%) patients were insured by commercial insurance in CNSR II, we limited our study population to participants with NRCMS, UBMIS and self-payment.

### Clinical outcomes

Patients were contacted by telephone at 3, 6 and 12 months after stroke onset by trained research personnel who followed standardised scripts to collect information on death, stroke recurrence and disability (defined as mRS score  $> 2$ ). During the follow-up periods, stroke recurrences associated with rehospitalisation were sourced to the attended hospitals to ensure reliable diagnosis. In case of a suspected recurrent cerebrovascular event without hospitalisation, judgement was made by the research coordinators together with the principal investigator.

### Loss to follow-up

A patient was regarded to have been lost to follow-up if consent to participate was withdrawn or no contact could be made after three telephone calls each day (morning, afternoon and early evening) for a working week at each follow-up point. Our report was based on patients with at least one set of follow-up information obtained at 3, 6 and 12 months, or with completed data of in-hospital outcomes. We used last observation carried forward to handle missing data, which means the outcomes of patients lost to follow-up would be imputed by the latest available outcomes from in-hospital to 12-month follow-up.

### Statistical analysis

For patients' baseline characteristics, continuous and categorical variables were reported as mean $\pm$ SD or frequencies (percentages), respectively. For the NIHSS, we reported both median (IQR) and categorised frequencies (percentages). Comparisons of continuous variables between groups were performed by analysis of variance or

Kruskal-Wallis test when appropriate, and of categorical variables by  $\chi^2$  test.

For all-cause death and stroke recurrence, the Cox proportional hazard model was used to analyse the relationship between health insurance status and 1-year clinical outcomes in both unadjusted and multivariate-adjusted models. We used the shared frailty model of the Cox model in which hospitals were incorporated into the SAS PHREG procedure's random statement and regarded as independent and identically distributed random variables.<sup>24</sup> Considering death is the competing risk of stroke recurrence, we used the competing-risks analysis of Fine and Gray<sup>25</sup> to assess the association between insurance status and stroke recurrence. For disability, we used a generalised estimating equation model to control the cluster effect of the hospital to get a more precise estimation.<sup>26</sup> To achieve model parsimony and stability, we first used backward selection methods with the default alpha of 0.05 to select covariates from an overall list of candidate risk factors for each outcome, and then adjusted for the selected covariates in multivariate models. The candidate risk factors affecting clinical outcomes were selected on the basis of the literature reviews, clinical plausibility and variables collected in the database. These candidate risk factors included age, education level, household income, mRS score before stroke onset, NIHSS score on admission, smoking, drinking, previous stroke or TIA, hypertension, diabetes mellitus, dyslipidaemia, atrial fibrillation, coronary heart disease, myocardial infarction, heart failure, peripheral vascular disease, hospital level, antiplatelets and anticoagulants.

To be more specific, we also assessed the association between insurance status and 1-year outcomes stratified by acute cerebrovascular disease types. We reanalysed the data on ischaemic stroke, TIA and intracerebral haemorrhage separately. We did not analyse patients with subarachnoid haemorrhage because there were only a few patients in this stratum.

All *p* values are two-sided, with *p*<0.05 considered statistically significant. All statistical analyses were performed using SAS V.9.4 software.

## RESULTS

The CNSR II study enrolled a total of 25 108 patients with acute cerebrovascular diseases, of whom 77 patients with commercial insurance were excluded. The remaining 24 941 patients were included in our data analysis.

### Demographical and clinical characteristics

Among the 24 941 analysed patients, 12 445 (49.9%) were covered by UBMIS, 10 283 (41.2%) were covered by NRCMS and 2 213 (8.9%) were self-payment. Patients covered by UBMIS were older, and had higher education, income and prevalence of vascular risk factors, such as history of stroke/TIA, heart failure or myocardial infarction, diabetes mellitus, dyslipidaemia, and atrial fibrillation, but had lower NIHSS scores compared with those covered by NRCMS. Ischaemic stroke was the primary

type of cerebrovascular disease in patients in all three insurance groups. However, the proportion of TIA was higher in patients covered by UBMIS, and intracerebral haemorrhage was more prevalent in patients covered by NRCMS (*p*<0.0001). Other details are shown in [table 1](#).

### Insurance status and 1-year clinical outcomes

During the 1-year follow-up period after stroke onset, 259 (9.1%) had all-cause deaths, 1674 (6.7%) had stroke recurrence and 8419 (33.8%) had disability. The Kaplan-Meier curves were significantly different among the different insurance programme groups for all-cause death ([figure 1](#); log-rank, *p*<0.0001) but not for stroke recurrence ([figure 2](#); Gray test, *p*=0.0523). The number and percentage of outcomes and missing values at every period from in-hospital to 12-month visit are reported in online supplementary table 1.

In the Cox model analysis, we found that compared with inpatients covered by UBMIS, those covered by NRCMS were associated with a significantly higher risk of 1-year mortality (9.7% vs 8.6%, crude HR: 1.32, 95% CI 1.18 to 1.46, *p*<0.0001). After adjusting for the relevant covariates, the risk remained 32% higher (adjusted HR: 1.32, 95% CI 1.17 to 1.48, *p*<0.0001). We also found a greater higher risk of 1-year stroke recurrence in the crude analysis (7.2% vs 6.5%, crude HR: 1.11 (95% CI 1.01 to 1.23), *p*=0.0357) and in the adjusted results (adjusted HR: 1.12, 95% CI 1.11 to 1.37, *p*<0.0001). With regard to 1-year disability, patients covered by NRCMS also showed a higher risk in the crude analysis (32.0% vs 26.3%, crude OR: 1.32, 95% CI 1.25 to 1.41, *p*<0.0001) and in the adjusted analysis (adjusted OR: 1.29, 95% CI 1.21 to 1.39, *p*<0.0001). Self-payment insurance patients had a similar risk of all-cause mortality as patients covered by UBMIS (adjusted HR: 1.18, 95% CI 0.99 to 1.42, *p*=0.0702), and stroke recurrence (adjusted HR: 1.03, 95% CI 0.86 to 1.25, *p*=0.7261), but higher risk of disability (adjusted OR: 1.27, 95% CI 1.14 to 1.42, *p*<0.0001) ([table 2](#)).

### Stratified analysis

The stratified analysis in [table 3](#) showed that 1-year outcome risks varied among different cerebrovascular disease types. Among patients with ischaemic stroke, compared with patients covered by UBMIS, patients covered by NRCMS had a 34% higher risk of all-cause death (adjusted HR: 1.34, 95% CI 1.18 to 1.54, *p*<0.0001), 34% higher risk of stroke recurrence (adjusted HR: 1.34, 95% CI 1.20 to 1.51, *p*<0.0001) and 30% higher risk of disability (adjusted HR: 1.30, 95% CI 1.21 to 1.41, *p*<0.0001). However, we did not see patients covered by NRCMS had a higher risk of all-cause death, stroke recurrence and disability among other types of cerebrovascular diseases, except for the higher risk of disability among patients with intracerebral haemorrhage (adjusted OR: 1.27, 95% CI 1.06 to 1.52, *p*=0.0112). Self-payment patients had a similar risk of 1-year outcomes to patients covered by UBMIS among all types of cerebrovascular diseases.

**Table 1** Baseline characteristics by insurance status

Variables	UBMIS (n=12445)	NRCMS (n=10283)	Self-payment (n=2213)	P values
Age, mean±SD	65.8±12.1	63.1±11.7	61.3±13.1	<0.0001
Male	8320 (66.9)	5838 (56.8)	1454 (65.7)	<0.0001
Education				<0.0001
Elementary or below	3926 (31.5)	6480 (63.0)	1040 (47.0)	
Middle school	3131 (25.2)	2215 (21.5)	483 (21.8)	
High school or above	5388 (43.3)	1588 (15.4)	690 (31.2)	
Family monthly income per capita				<0.0001
≤1000	938 (7.5)	4088 (39.8)	333 (15.0)	
>1000	8151 (65.5)	3399 (33.1)	894 (40.4)	
Unknown	3356 (27.0)	2796 (27.2)	986 (44.6)	
NIHSS score, median (IQR)	3.0 (1.0–6.0)	4.0 (2.0–8.0)	4.0 (2.0–7.0)	<0.0001
NIHSS score, categories				<0.0001
0–4	6540 (52.6)	4683 (45.5)	952 (43.0)	
5–14	4991 (40.1)	4642 (45.1)	1088 (49.2)	
≥15	914 (7.3)	958 (9.3)	173 (7.8)	
Cerebrovascular disease				<0.0001
Ischaemic stroke	9939 (79.9)	7654 (74.4)	1748 (79.0)	
Transient ischaemic attack	1241 (10.0)	789 (7.7)	125 (5.6)	
Intracerebral haemorrhage	1107 (8.9)	1639 (15.9)	296 (13.4)	
Subarachnoid haemorrhage	95 (0.8)	169 (1.6)	33 (1.5)	
Unspecified	63 (0.5)	32 (0.3)	11 (0.5)	
Smoking	5473 (44.0)	4260 (41.4)	987 (44.6)	0.0002
Drinking	3752 (30.1)	2858 (27.8)	713 (32.2)	<0.0001
Previous stroke/TIA	4828 (38.8)	3085 (30.0)	592 (26.8)	<0.0001
Heart failure/MI	603 (4.8)	294 (2.9)	75 (3.4)	<0.0001
Hypertension	9580 (77.0)	7788 (75.7)	1671 (75.5)	0.0570
Diabetes mellitus	3605 (29.0)	1877 (18.3)	491 (22.2)	<0.0001
Dyslipidaemia	4374 (35.1)	3213 (31.2)	580 (26.2)	<0.0001
AF	1092 (8.8)	677 (6.6)	185 (8.4)	<0.0001
Peripheral artery disease	649 (5.2)	379 (3.7)	118 (5.3)	<0.0001
mRS score				<0.0001
0–2	11 117 (89.3)	9398 (91.4)	1977 (89.3)	
3–5	1328 (10.7)	885 (8.6)	236 (10.7)	
Antiplatelets	9169 (73.7)	7111 (69.2)	1481 (66.9)	<0.0001
Anticoagulants among AF	107/1092 (9.8)	80/677 (11.8)	17/185 (9.2)	0.3391
Tertiary hospital	9795 (78.7)	5655 (55.0)	1747 (78.9)	<0.0001

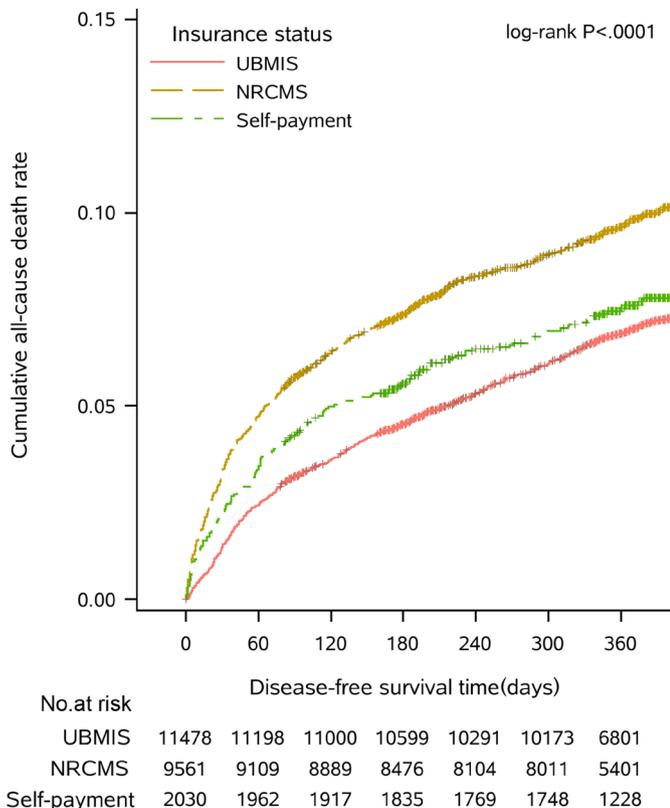
AF, atrial fibrillation; MI, myocardial infarction; mRS, modified Rankin Scale; NIHSS, National Institutes of Health Stroke Scale; NRCMS, New Rural Cooperative Medical Scheme; TIA, transient ischaemic attack; UBMIS, Urban Basic Medical Insurance Scheme.

## DISCUSSION

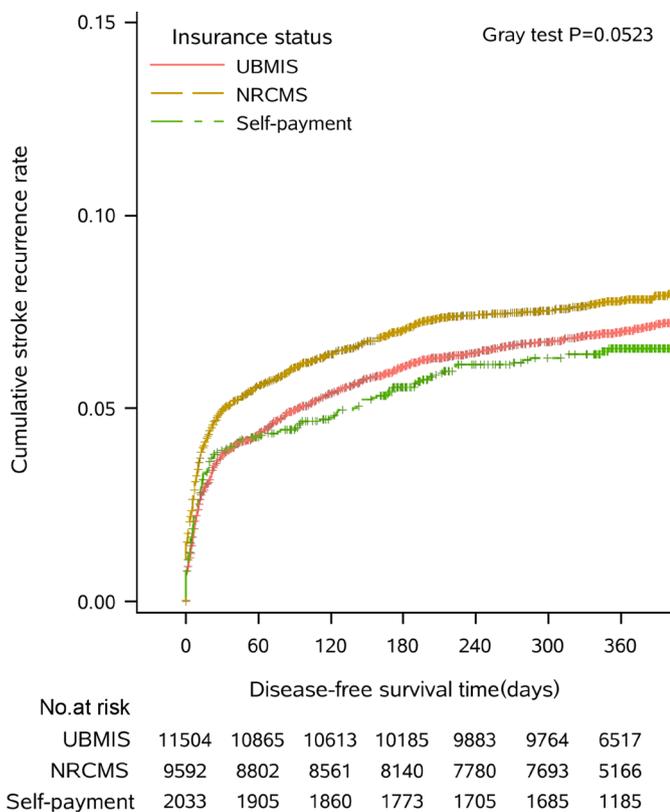
This national registry study demonstrated that health insurance status is significantly associated with 1-year outcomes for patients with stroke and TIA in China. Compared with patients covered by UBMIS, patients covered by NRCMS have 32% higher risk of all-cause death, 12% higher risk of stroke recurrence and more

than 29% greater risk of disability. In addition, we found that the risk for unfavourable outcomes was mainly among patients with ischaemic stroke.

China has made an impressive achievement in both the scale of coverage and the speed of expansion of its health insurance system. Among the above-mentioned insurance programmes in China, the UEBMI covers more than 95%



**Figure 1** Cumulative Kaplan-Meier estimates of the time to all-cause death. NRCMS, New Rural Cooperative Medical Scheme; UBMIS, Urban Basic Medical Insurance Scheme.



**Figure 2** Cumulative Kaplan-Meier estimates of the time to stroke recurrence. NRCMS, New Rural Cooperative Medical Scheme; UBMIS, Urban Basic Medical Insurance Scheme.

of urban employees and retired employees, the URBMI also covers more than 95% of urban residents, and the NRCMS covers almost 99% of rural residents. UEBMI and URBMI compose the UBMIS. NRCMS and UBMIS have covered almost the entire Chinese population, leaving only a small percentage of self-payment and commercial insurance.<sup>27</sup> Therefore, we abstracted patients with NRCMS, UBMIS and self-payment. However, due to the differences in insurance premiums and reimbursement rates, differences in health service utilisation and disease outcomes exist between NRCMS and UBMIS. So we emphasised comparisons between NRCMS and UBMIS. In addition to the disparities between NRCMS and UBMIS, we found that the self-payment group was not significantly associated with poor outcomes compared with the UBMIS group. One possible reason is that some of the self-payment patients with NRCMS or UBMIS transferred to other provincial hospitals, who could report self-payment insurance status. However, we do not have enough data to evaluate this in detail.

Most of the previous studies<sup>7 9 28-31</sup> have found that insurance status is an independent indicator of stroke outcome. Some previous studies demonstrated that patients with stroke with health insurance were less likely to experience unfavourable outcomes than those without health insurance,<sup>7 9 28</sup> and some other studies have shown that patients with private health insurance had a lower risk for unfavourable outcomes than those with other health insurance.<sup>30 31</sup> Currently, most private health insurance programmes provide supplemental insurance products to complement public health insurance programmes. The higher rate and broader range of reimbursements may lead to greater utilisation of health service and better health outcomes.<sup>21</sup> Our data showed that patients covered by NRCMS had less use of antiplatelets and are less hospitalised to tertiary hospitals, and these may be largely due to the lower reimbursement of NRCMS. In addition, patients covered by NRCMS had generally disadvantaged social economic status (eg, less educated, lower income) and more severe stroke disease (higher NIHSS score, more intracerebral haemorrhage). Studies have reported that lower social economic status and higher NIHSS scores have more severe deficits and higher mortality risk.<sup>32 33</sup> This may also partly explain the outcome difference between UBMIS and NRCMS.

Numerous studies have indicated that health insurance can reduce disparities in access to care and health outcomes.<sup>1 6 34 35</sup> Researchers believe that fragmentation in social health insurance schemes is a major factor for inequitable access to healthcare and financial protection.<sup>27 31 36</sup> Many existing studies have demonstrated the association between health insurance and patients' outcomes.<sup>1</sup> One reason is that the fragmentation of health insurance means poor health insurance funding pools, which leads to differential benefit packages, and unequal access to needed care and financial protection.<sup>37 38</sup> Rural populations have more restricted access to healthcare and also have a higher economic burden than

**Table 2** Association between risk factors and 1-year outcomes

Variables	Patients (n)	1-year outcomes, n (%)	Crude results		Adjusted results	
			HR/OR (95% CI)	P values	HR/OR (95% CI)	P values
<b>All-cause death*</b>						
Insurance status						
NRCMS	10283	994 (9.7)	1.32 (1.18 to 1.46)	<0.0001	1.32 (1.17 to 1.48)	<0.0001
Self-payment	2213	191 (8.6)	1.07 (0.90 to 1.28)	0.4349	1.18 (0.99 to 1.42)	0.0702
UBMIS	12445	1074 (8.6)	Ref		Ref	
<b>Stroke recurrence†</b>						
Insurance status						
NRCMS	10283	739 (7.2)	1.11 (1.01 to 1.23)	0.0357	1.12 (1.11 to 1.37)	<0.0001
Self-payment	2213	129 (5.8)	0.91 (0.75 to 1.09)	0.3003	1.03 (0.86 to 1.25)	0.7261
UBMIS	12445	806 (6.5)	Ref		Ref	
<b>Disability‡</b>						
Insurance status						
NRCMS	9398	3011 (32.0)	1.32 (1.25 to 1.41)	<0.0001	1.29 (1.21 to 1.39)	<0.0001
Self-payment	1977	619 (31.3)	1.28 (1.15 to 1.42)	<0.0001	1.27 (1.14 to 1.42)	<0.0001
UBMIS	11117	2919 (26.3)	Ref		Ref	

\*Adjusted for age, mRS score, family monthly income per capita, smoking, drinking, NIHSS score on administration, cerebrovascular disease type, previous stroke or TIA, heart failure/myocardial infarction, dyslipidaemia, hospital level, antiplatelets and anticoagulants in the Cox model with consideration of the hospital's cluster effect.

†Adjusted for age, mRS score, family monthly income per capita, drinking, NIHSS score on administration, previous stroke or TIA, heart failure/myocardial infarction, hypertension, diabetes mellitus, hospital level, antiplatelets and anticoagulants in the Cox model with consideration of the hospital's cluster effect.

‡Adjusted for age, sex, education, mRS score, cerebrovascular diseases type, smoking, drinking, heart failure or myocardial infarction, diabetes mellitus, hospital level, antiplatelets and anticoagulants in the generalised equation estimation model.  
mRS, modified Rankin Scale; NIHSS, National Institutes of Health Stroke Scale; NRCMS, New Rural Cooperative Medical Scheme; Ref, reference; TIA, transient ischaemic attack; UBMIS, Urban Basic Medical Insurance Scheme.

urban residents in China.<sup>27</sup> Our results were consistent with evidence from a cardiovascular disease research in China.<sup>11</sup>

Our findings will provide convictive evidence and valuable insight into the promotion of the universal medical insurance. After the release of 'Basic medical insurance for urban and rural residents in Beijing' in December 2017, Beijing has merged UBMIS and NRCMS, and the universal medical insurance has been available for all urban and rural residents in Beijing since 1 January 2018. The reimbursement rate for inpatients is as high as 80%, and the financial assistance increased by 40%.<sup>39</sup> All these efforts will pave the way for equal access to healthcare, especially for rural residents.

The strength of this study is that it is a large-scale, nationwide, prospective, registry project-based study that explores the association between insurance status and 1-year outcome for patients with stroke and TIA. Using high-quality data obtained through systematic and standardised approach and statistical methods considering the cluster effect of the hospital and competing risk of stroke, we got a more precise estimation. To test the targeted association of different cerebrovascular disease types, we also used stratified analysis, and the association mainly remained in ischaemic stroke.

This study had some limitations. First, the sampling method we used did not strictly represent nationwide hospitals. Therefore, caution is needed in interpreting the data. Given the vast number of hospitals in China, it would be practically impossible to conduct a genuinely representative study. Being cognizant of this limitation, the steering committee selected hospitals with the consideration of both representations of hospitals and feasibility of the study in the design phase. In the analysis phase, we considered a hospital as a random cluster factor and we adjusted hospital level in multiregression models. These measures helped improve the robustness of the study. Second, 1-year outcomes obtained by telephone follow-up were not an accurate measurement. However, centralised follow-up conducted by trained research personnel with standardised scripts would minimise the inter-rater disagreement, and this is also a practical approach to conduct such a large-scale study. Third, patients lost to follow-up may substantially bias the results if the characteristics are different between missing and non-missing outcomes groups. However, the supplemental analysis showed that there was no significant difference between these two groups of population except for education (online supplementary table 2). Last, insurance is nearly completely depending on the sociodemographic feature

**Table 3** Association between risk factors and 1-year outcomes stratified by cerebrovascular disease type

Variables	Patients (n)	1-year outcomes, n (%)	Crude results		Adjusted results	
			HR/OR (95% CI)	P values	HR/OR (95% CI)	P values
<b>All-cause death*</b>						
Ischaemic stroke						
NRCMS	7654	669 (8.7)	1.26 (1.11 to 1.42)	0.0002	1.34 (1.18 to 1.54)	<0.0001
Self-payment	1748	146 (8.4)	1.06 (0.87 to 1.30)	0.5407	1.20 (0.98 to 1.47)	0.0703
UBMIS	9939	830 (8.4)	Ref		Ref	
Transient ischaemic attack						
NRCMS	789	18 (2.3)	1.10 (0.61 to 2.01)	0.7487	1.17 (0.59 to 2.30)	0.6588
Self-payment	125	3 (2.4)	1.13 (0.34 to 3.75)	0.8358	1.23 (0.36 to 4.22)	0.7381
UBMIS	1241	28 (2.3)	Ref		Ref	
Intracerebral haemorrhage						
NRCMS	1639	277 (16.9)	1.22 (0.96 to 1.54)	0.0999	1.27 (0.98 to 1.64)	0.0674
Self-payment	296	39 (13.2)	0.89 (0.57 to 1.38)	0.6094	1.09 (0.70 to 1.71)	0.6969
UBMIS	1107	191 (17.3)	Ref		Ref	
<b>Stroke recurrence†</b>						
Ischaemic stroke						
NRCMS	7654	557 (7.3)	1.16 (1.03 to 1.30)	0.0115	1.34 (1.20 to 1.51)	<0.0001
Self-payment	1748	103 (5.9)	0.93 (0.76 to 1.15)	0.4935	1.06 (0.86 to 1.31)	0.5795
UBMIS	9939	629 (6.3)	Ref		Ref	
Transient ischaemic attack						
NRCMS	789	46 (5.8)	0.88 (0.62 to 1.27)	0.5000	0.94 (0.65 to 1.37)	0.7558
Self-payment	125	9 (7.2)	1.14 (0.57 to 2.26)	0.7127	1.05 (0.54 to 2.02)	0.8931
UBMIS	1241	82 (6.6)	Ref		Ref	
Intracerebral haemorrhage						
NRCMS	1639	116 (7.1)	0.88 (0.67 to 1.17)	0.3856	0.93 (0.70 to 1.26)	0.6561
Self-payment	296	16 (5.4)	0.72 (0.42 to 1.22)	0.2189	0.89 (0.52 to 1.55)	0.6897
UBMIS	1107	85 (7.7)	Ref		Ref	
<b>Disability‡</b>						
Ischaemic stroke						
NRCMS	6968	2185 (31.4)	1.24 (1.16 to 1.33)	<0.0001	1.30 (1.21 to 1.41)	<0.0001
Self-payment	1552	488 (31.4)	1.25 (1.11 to 1.40)	0.0002	1.33 (1.18 to 1.51)	<0.0001
UBMIS	8820	2373 (26.9)	Ref		Ref	
Transient ischaemic attack						
NRCMS	775	59 (7.6)	1.08 (0.77 to 1.53)	0.6437	1.31 (0.90 to 1.91)	0.1649
Self-payment	120	12 (10.0)	1.46 (0.77 to 2.76)	0.2409	1.74 (0.90 to 3.36)	0.0992
UBMIS	1218	86 (7.1)	Ref		Ref	
Intracerebral haemorrhage						
NRCMS	1465	718 (49.0)	1.14 (0.97 to 1.35)	0.1063	1.27 (1.06 to 1.52)	0.0112
Self-payment	263	112 (42.6)	0.88 (0.67 to 1.16)	0.3792	1.01 (0.75 to 1.34)	0.9709
UBMIS	940	429 (45.6)	Ref		Ref	

\*Adjusted for age, mRS score, family monthly income per capita, smoking, drinking, NIHSS score on administration, cerebrovascular disease type, previous stroke or TIA, heart failure/myocardial infarction, dyslipidaemia, hospital level, antiplatelets and anticoagulants in the Cox model with consideration of the hospital's cluster effect.

†Adjusted for age, mRS score, family monthly income per capita, drinking, NIHSS score on administration, previous stroke or TIA, heart failure/myocardial infarction, hypertension, diabetes mellitus, hospital level, antiplatelets and anticoagulants in the Cox model with consideration of the hospital's cluster effect.

‡Adjusted for age, sex, education, mRS score, cerebrovascular disease type, smoking, drinking, heart failure or myocardial infarction, diabetes mellitus, hospital level, antiplatelets and anticoagulants in the generalised equation estimation model.

mRS, modified Rankin Scale; NIHSS, National Institutes of Health Stroke Scale; NRCMS, New Rural Cooperative Medical Scheme; Ref, reference; TIA, transient ischaemic attack; UBMIS, Urban Basic Medical Insurance Scheme.

of urban or rural living. Therefore it is tough to determine if the differences can be attributed to insurance status as proposed, or to unmeasured factors including life-style issues or even ethnic/genetic variations. Although we could not have all these confounders controlled, we made a reasonable covariates list for adjustment, and the results were consistent with other studies.

## CONCLUSIONS

In conclusion, in this nationwide registry study, we found that patients with stroke and TIA covered by NRMCS have a higher risk of 1-year all-cause death, stroke recurrence and disability than those covered by UBMIS, especially patients with ischaemic stroke. Further research aiming to assess the underlining reasons affecting resource accessibility and health service utilisation among different health insurance statuses would be helpful. Improving accessibility of health service for rural insurance patients with ischaemic stroke may improve stroke outcomes and lower the stroke burden in China, especially in rural regions.

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## REFERENCES

- Levy H, Meltzer D. The impact of health insurance on health. *Annu Rev Public Health* 2008;29:399–409.
- Dor A, Sudano J, Baker DW. The effect of private insurance on the health of older, working age adults: evidence from the health and retirement study. *Health Serv Res* 2006;41(3 Pt 1):759–87.
- Hadley J, Waidmann T. Health insurance and health at age 65: implications for medical care spending on new Medicare beneficiaries. *Health Serv Res* 2006;41:429–51.
- Sun Y, Gregersen H, Yuan W. Chinese health care system and clinical epidemiology. *Clin Epidemiol* 2017;9:167–78.
- Blumenthal D, Hsiao W. Lessons from the East—China's rapidly evolving health care system. *N Engl J Med* 2015;372:1281–5.
- Freeman JD, Kadiyala S, Bell JF, et al. The causal effect of health insurance on utilization and outcomes in adults: a systematic review of US studies. *Med Care* 2008;46:1023–32.
- McManus M, Ovbigele B, Markovic D, et al. Association of Insurance Status with Stroke-Related Mortality and Long-term Survival after Stroke. *J Stroke Cerebrovasc Dis* 2015;24:1924–30.
- Kreindel S, Rosetti R, Goldberg R, et al. Health insurance coverage and outcome following acute myocardial infarction. A community-wide perspective. *Arch Intern Med* 1997;157:758–62.
- Shen JJ, Washington EL. Disparities in outcomes among patients with stroke associated with insurance status. *Stroke* 2007;38:1010–6.
- Zhang X, Zhang Y, Xiao X, et al. The relation between health insurance and management of hypertension in Shanghai, China: a cross-sectional study. *BMC Public Health* 2016;16:959.
- Liu B, Yan H, Guo R, et al. The basic social medical insurance is associated with clinical outcomes in the patients with ST-elevation myocardial infarction: a retrospective study from Shanghai, China. *Int J Med Sci* 2014;11:905–17.
- Yan R, Li W, Yin L, et al. Cardiovascular diseases and risk-factor burden in urban and rural communities in high-, middle-, and low-income regions of china: a large community-based epidemiological study. *J Am Heart Assoc* 2017;6:e004445.
- Xu F, Ah Tse L, Yin X, et al. Impact of socio-economic factors on stroke prevalence among urban and rural residents in Mainland China. *BMC Public Health* 2008;8:170–70.
- Zhang XH, Guan T, Mao J, et al. Disparity and its time trends in stroke mortality between urban and rural populations in China 1987 to 2001: changing patterns and their implications for public health policy. *Stroke* 2007;38:3139–44.
- Johnston SC, Mendis S, Mathers CD. Global variation in stroke burden and mortality: estimates from monitoring, surveillance, and modelling. *Lancet Neurol* 2009;8:345–54.
- Strong K, Mathers C, Bonita R. Preventing stroke: saving lives around the world. *Lancet Neurol* 2007;6:182–7.
- Wang W, Jiang B, Sun H, et al. Prevalence, incidence, and mortality of stroke in china: results from a nationwide population-based survey of 480687 adults. *Circulation* 2017;135:759–71.
- The Ministry of Health of the People's Republic of China. *2010 Annual chinese healthcare statistics*. Beijing: China Union Medical University Publication, 2010.
- Yang X, Li Z, Zhao X, et al. Use of warfarin at discharge among acute ischemic stroke patients with nonvalvular atrial fibrillation in China. *Stroke* 2016;47:464–70.
- Li Z, Wang C, Zhao X, et al. Substantial progress yet significant opportunity for improvement in stroke care in China. *Stroke* 2016;47:2843–9.
- Wang Y, Cui L, Ji X, et al. The China National Stroke Registry for patients with acute cerebrovascular events: design, rationale, and baseline patient characteristics. *Int J Stroke* 2011;6:355–61.
- Rankin J. Cerebral vascular accidents in patients over the age of 60. II. Prognosis. *Scott Med J* 1957;2:200–15.
- Lyden P, Brott T, Tilley B, et al. Improved reliability of the NIH Stroke Scale using video training. NINDS TPA Stroke Study Group. *Stroke* 1994;25:2220–6.
- Wienke A. *Frailty models in survival analysis*: CRC Press, 2010.
- Fine JP, Gray RJ. A proportional hazards model for the subdistribution of a competing risk. *J Am Stat Assoc* 1999;94:496–509.
- Hardin JW. *Generalized estimating equations (GEE)*: Wiley Online Library, 2005.
- Meng Q, Fang H, Liu X, et al. Consolidating the social health insurance schemes in China: towards an equitable and efficient health system. *Lancet* 2015;386:1484–92.
- Gezmu T, Gizzi MS, Kirmani JF, et al. Disparities in acute stroke severity, outcomes, and care relative to health insurance status. *J Stroke Cerebrovasc Dis* 2014;23:e93–e98.
- Fargen KM, Neal D, Blackburn SL, et al. Health disparities and stroke: the influence of insurance status on the prevalence of patient safety indicators and hospital-acquired conditions. *J Neurosurg* 2015;122:870–5.
- Hasan O, Orav EJ, Hicks LS. Insurance status and hospital care for myocardial infarction, stroke, and pneumonia. *J Hosp Med* 2010;5:452–9.
- James ML, Grau-Sepulveda MV, Olson DM, et al. Insurance status and outcome after intracerebral hemorrhage: findings from Get With The Guidelines-stroke. *J Stroke Cerebrovasc Dis* 2014;23:283–92.
- Fonarow GC, Saver JL, Smith EE, et al. Relationship of national institutes of health stroke scale to 30-day mortality in medicare beneficiaries with acute ischemic stroke. *J Am Heart Assoc* 2012;1:42–50.
- Addo J, Ayerbe L, Mohan KM, et al. Socioeconomic status and stroke: an updated review. *Stroke* 2012;43:1186–91.
- Currie J, Decker S, Lin W. Has public health insurance for older children reduced disparities in access to care and health outcomes? *J Health Econ* 2008;27:1567–81.
- Franks P, Clancy CM, Gold MR. Health insurance and mortality. Evidence from a national cohort. *JAMA* 1993;270:737–41.
- Skolarus LE, Meurer WJ, Burke JF, et al. Effect of insurance status on postacute care among working age stroke survivors. *Neurology* 2012;78:1590–5.
- McIntyre D, Ranson MK, Aulakh BK, et al. Promoting universal financial protection: evidence from seven low- and middle-income



- countries on factors facilitating or hindering progress. *Health Res Policy Syst* 2013;11:36.
38. McIntyre D, Garshong B, Mtei G, *et al.* Beyond fragmentation and towards universal coverage: insights from Ghana, South Africa and the United Republic of Tanzania. *Bull World Health Organ* 2008;86:871–6.
39. The State Council of the People's Republic of China. [http://www.gov.cn/xinwen/2017-12/14/content\\_5246738.htm](http://www.gov.cn/xinwen/2017-12/14/content_5246738.htm)