Long-term prognosis and prognostic determinants of patients with first attack of mild and moderate ischemia at Beijing community hospitals

Xianghua Fang¹, ², Liming Li³, Xinqing Zhang³, Hongjun Liu², Hongmei Zhang⁴, Xiaoming Qin³

¹Department of Geriatrics, Xuanwu Hospital, Capital Medical University, Beijing 100053, China
²Department of Neurology, Xuanwu Hospital, Capital Medical University, Beijing 100053, China
³Department of Evidence-based Medicine, Xuanwu Hospital, Capital Medical University, Beijing 100053, China
⁴Department of Geriatrics, Xuanwu Hospital, Capital Medical University, Beijing 100053, China

Abstract
A total of 710 patients with first-ever ischemic stroke were consecutively recruited between January 2003 and December 2004 from five community hospitals/stations in five districts of Beijing, China. As of December 31, 2008, a total of 2 477 person-years were followed-up. During the five-year follow-ups, 117 adverse events occurred, including all-cause death and acute cardiovascular events (recurrent stroke, acute myocardial infarction, and sudden death). The five-year cumulative mortality rate was 2.18/100 person-years (54 cases), with 3.88/100 person-years (96 cases) of acute cardiovascular events and 3.02/100 person-years (75 cases) of recurrent stroke. Multiple factor analyses using the Cox proportional hazards ratio models showed that age, diabetes, and dependence of activities of daily living were independent predictors for death, acute cardiovascular disease events, or recurrent stroke. The results demonstrated that recurrent stroke was a major vascular disease that affected the prognosis of mild or moderate stroke patients. Secondary prevention of stroke patients should include active management of vascular risk factors and rehabilitation.

Key Words: ischemic stroke; follow-up study; predictors; prognosis; recurrent stroke; survival

INTRODUCTION
In recent decades, stroke, with characteristic high mortality and disability, has been the first leading cause of death and threatened health disease in middle-aged and elderly Chinese. Stroke also characteristically exhibits a high risk of recurrence and mortality, and these results are significantly greater in stroke patients than the general population. Epidemiological data have shown that the incidence of ischemic stroke (IS) increased during 1984 to 2001 in Beijing, and recurrent stroke accounted for one-third of all stroke events. This is a great challenge for secondary stroke prevention and continues to be of great concern for clinicians. Since 2002, several hospital-based, multi-center, registry studies focused on stroke prognosis and the influential risk factors have been completed, revealing important evidence for policy makers for the secondary and tertiary prevention of stroke. However, the majority of studies involved acute stroke patients from central hospitals (grade 1), and the follow-up period was only 1–1.4 years, which is too short to determine long-term prognosis in stroke patients. Studies from developed countries have suggested that the impact on stroke patient health and life persists as long as 10–20 years. To date, in China, there is no study of long-term prognosis and influencing factors in mild or moderate stroke patients. Prognosis is not only related to risk factors of stroke, but it is also influenced by medical healthcare systems and economic development in countries and regions. China is currently experiencing an economic transition, and the medical healthcare system is also in the process of a reform. Since 1999, the Chinese government has paid much attention to primary healthcare and prevention. Chronic disease patients, in particular patients with moderate and mild stroke, are encouraged to go to community hospitals for post-stroke treatment, rehabilitation, and risk factor management. The number of post-stroke patients in community hospitals has significantly increased in recent years. However, less attention has been paid to long-term
prognosis of these patients. The present study is a perspective study of prognosis and influencing factors in stroke patients living in Beijing. Five community hospitals were randomly selected from five urban districts in Beijing, and stroke patients were consecutively enrolled in the study and were treated at the community hospitals from 2003 to 2004. The patients were followed-up for 5 years, and prognosis and prognostic factors were analyzed.

RESULTS

Quantitative analysis of subjects
A total of 1,371 stroke patients were consecutively recruited between January 2003 and December 2004 from five community hospitals in five urban districts of Beijing, China. Among them, 710 cases with first-ever IS complied with the inclusive criteria and were included in the final analysis. The screening procedure is shown in Figure 1.

Baseline information
Baseline information from 710 patients with first-attack IS is shown in Table 1.

Follow-ups
Follow-up duration and rate
As of December 31, 2008, a total of 2,477 person-years was followed up in 710 patients with IS. The mean duration of follow-up was 3.5 ± 0.9 person-years (ranging 0.5–5 years). The response rate was 90% (639 cases), with a loss rate of 10.0% (71 cases lost from follow-up).

Mortality and proportional mortality rate
A total of 117 adverse events occurred (cumulative incidence of 4.72/100 person-years), of which there were 54 deaths (cumulative mortality rate of 2.18/100 person-years). Thirty-three deaths were due to acute cardiovascular disease (CVD), which accounted for 61% of all deaths. Among them, 19 deaths were due to recurrent stroke, 9 deaths were a result of acute myocardial infarction, and 5 deaths were from sudden death (Figure 2).

Table 1 Characteristics of enrolled patients

| Variable                          | Value       |
|-----------------------------------|-------------|
| Demographic characteristics       |             |
| Age (year)                        | 64.4±9.3    |
| Gender (male/female, n)           | 362/348     |
| Vascular risk factors             |             |
| SBP (mm Hg)                       | 135.1±16.0  |
| DBP (mm Hg)                       | 81.7±9.8    |
| FBG (mM)                          | 6.0±2.0     |
| TC (mM)                           | 5.181±1.060 |
| TG (mM)                           | 1.835±1.376 |
| HDL-C (mM)                        | 1.254±0.382 |
| LDL-C (mM)                        | 3.106±0.997 |
| BMI (kg/m²)                       | 25.4±3.2    |
| Prevalence of hypertension [n (%)]| 551(77.6)   |
| Prevalence of diabetes mellitus [n (%)] | 208(30.1) |
| Prevalence of dyslipidemia [n (%)] | 512(72.1)   |
| Prevalence of heart diseases [n (%)] | 244(34.4)   |
| Medications                       |             |
| Treatment rate of hypertension [n (%)] | 434(78.7)  |
| Control rate of hypertension (SBP<140 mm Hg and DBP<90 mm Hg) [n (%)] | 227(41.2)  |
| Treatment rate of diabetes mellitus [n (%)] | 166(79.8)  |
| Control rate of diabetes (FBG<7.0 mM) [n (%)] | 80(38.5)   |
| Treatment rate of dislipidemia [n (%)] | 158(22.9)  |
| Control rate of dislipidemia [n (%)] | 72(14.1)    |
| Treatment rate of aspirin [n (%)]  | 507(71.4)   |
| Unhealthy lifestyle               |             |
| Smoking before stroke [n (%)]     | 179(25.2)   |
| Drinking before stroke [n (%)]    | 129(18.2)   |
| Subtype of ischemic stroke        |             |
| Lacunar infarction [n (%)]        | 474(66.8)   |
| Non-lacunar infarction [n (%)]    | 236(33.2)   |
| Post-stroke condition             |             |
| ADL dependence [n (%)]            | 201(28.3)   |
| Mean BI score                     | 94±24.14.7  |
| Depression symptom [n (%)]        | 322(45.3)   |

SBP: Systolic blood pressure; DBP: diastolic blood pressure; FBG: fasting blood glucose; TC: total cholesterol; TG: triglyceride; HDL-C: high-density lipoproteins cholesterol; LDL-C: low-density lipoproteins cholesterol; BMI: body weight index; treatment rate: number of cured cases/total cases; control rate: number of controlled cases/total cases; BI: Barthel Index, total 100 scores, a higher score indicates independent of ADL; ADL dependence: number of dependent activities of daily living/total cases.

1 mm Hg = 0.133 kPa. Measurement data are expressed as mean±SD.
Acute CVD events and recurrent stroke

Among the 117 adverse events, 96 were acute CVD events (cumulative incidence of 3.88/100 person-years), which included 75 cases of recurrent stroke (78.1%, cumulative incidence of 3.03/100 person-years), 16 cases (16.7%) of acute myocardial infarction, and 5 cases (5.2%) of sudden death. Among the 75 recurrent stroke cases, 84% (63 cases) were IS and 16% (12 cases) were hemorrhagic stroke, including 1 case with subarachnoid hemorrhages (Figure 3).

Risk factors for death, acute CVD, and stroke

Multiple factor analyses using the Cox proportional hazards ratio models showed that aging was an independent predictor for death and acute CVD events in IS patients. With each one-year increment in age, the risks of all-cause death increased by 12% (hazard ratio (HR): 1.12, 95% confidence interval (CI): 1.07–1.17, P < 0.01) and the risk of acute CVD increased by 3% (HR: 1.03, 95% CI: 1.00–1.05, P > 0.05), respectively. Of vascular risk factors, diabetes mellitus was the only independent risk factor for acute CVD events and recurrent stroke. In IS patients with diabetes, the risks of acute CVD event and recurrent stroke were 2.07 times greater (HR: 2.07, 95% CI: 1.37–3.12, P < 0.01) and 2.09 times greater (HR: 2.09, 95% CI: 1.31–3.32, P < 0.005) compared to patients without diabetes. Multiple-factor analyses by Cox proportional hazards ratio models also showed that activities of daily living (ADL) dependence was an independent predictor of all-cause death in IS patients. The risk of death was 4.09 (HR: 4.09, 95% CI: 2.17–7.71, P < 0.01) times greater in IS patients with ADL dependence than ADL-independent patients (Table 2).

DISCUSSION

To the best of our understanding, the present study was the first long-term study of prognostic determinants in patients with mild and moderate IS treated at community hospitals. The five-year cumulative mortality of mild and moderate IS patients is 2.18 per 100 person-years, the incident rate of acute CVD is 3.88 per 100 person-years, and the incident rate of recurrent stroke is 3.02 per 100 person-years. These figures were much greater than the general population[3, 12], but less than two hospital-based registry studies[4-5] and one community-based registry study[6] from China. The one-year mortality rate for IS patients was 12.5–13.8%[4-5], and the stroke recurrent rate was 11.2%[4] as reported by Liu and Wu, respectively[4-6]. The time and source of enrolling stroke patients and evaluation might explain these differences. Both mortality rate and recurrent rate were greater during the acute phase in stroke patients, especially within one month of stroke onset. Liu et al[4] and Wu et al[6] enrolled and evaluated IS patients during the acute stage (within 1 month after acute stroke onset) in grade-III hospitals. In urban China, patients during the acute stage and critically ill patients usually seek medical help at grade III or grade II hospitals, where neurologists, stroke units, and neuro-imaging equipment are utilized for diagnosis to offer treatment quickly and accurately. However, post-stroke patients (14 days to 1 month after acute stroke onset) with moderate or mild stroke tend to go to community hospitals for post-stroke treatment, rehabilitation, and risk factor management.

Table 2 Survival models for determinants of five-year mortality, incidence of acute CVD events and recurrent stroke events in 710 patients with first-stroke

| Factors 3 months after first stroke | All-cause death | Acute CVD event | Recurrent stroke |
|-----------------------------------|-----------------|-----------------|-----------------|
|                                   | Adjusted HR and 95% CI* | P          | Adjusted HR and 95% CI* | P          | Adjusted HR and 95% CI* | P          |
| Age                               | 1.12 (1.07–1.17)   | <0.01           | 1.03 (1.00–1.05)   | 0.051           | 1.01 (0.98–1.04) | 0.434           |
| Gender (male vs. female)          | 0.55 (0.25–1.20)   | 0.132           | 0.64 (0.38–1.07)   | 0.090           | 0.55 (0.30–1.01) | 0.052           |
| Hypertension (no vs. yes)         | 0.67 (0.33–1.37)   | 0.268           | 1.07 (0.97–3.96)   | 0.063           | 0.50 (0.48–4.99) | 0.055           |
| Diabetes (no vs. yes)             | 1.01 (0.91–2.86)   | 0.104           | 2.07 (1.37–3.12)   | 0.001           | 2.09 (1.31–3.32) | 0.002           |
| Dyslipidemia (no vs. yes)         | 0.65 (0.36–1.16)   | 0.144           | 0.90 (0.57–1.42)   | 0.649           | 1.11 (0.65–1.91) | 0.700           |
| Heart diseases (no vs. yes)       | 1.21 (0.68–2.17)   | 0.521           | 1.31 (0.86–2.00)   | 0.215           | 1.21 (0.75–1.97) | 0.435           |
| Overweight or obese (no vs. yes)  | 0.79 (0.44–1.42)   | 0.434           | 0.31 (0.66–1.26)   | 0.888           | 1.03 (0.62–1.72) | 0.906           |
| Smoking (never vs. current or ever)| 1.13 (0.57–2.23)   | 0.721           | 0.91 (0.54–1.53)   | 0.710           | 0.73 (0.40–1.32) | 0.297           |
| Alcohol drinking (never vs. current or ever) | 1.58 (0.79–3.23) | 0.201           | 1.20 (0.69–2.08)   | 0.528           | 1.44 (0.78–2.68) | 0.247           |
| ADL (totally independence vs. dependence) | 4.09 (2.17–7.71) | <0.01           | 1.52 (0.97–2.39)   | 0.065           | 1.49 (0.89–2.47) | 0.126           |

*Multiple-factor analysis of COX proportional hazards model, confounding factors were corrected. Acute CVD includes acute myocardial infarction, sudden death, and acute stroke; Recurrent stroke includes ischemic stroke, intracerebral hemorrhage, and subarachnoid hemorrhage. HR: hazard ratio; CI: confidence interval; ADL: activities of daily living; CVD: cardiovascular disease.
Accordingly, a study should be designed to explore prognosis of stroke patients from a community. A community-based study by Ding et al. [4-5] showed that the 1.4-year cumulative recurrent stroke rate was 5.2% and incident rate of coronary heart disease was 5.2%, which were significantly less than two previous hospital-based studies and one community-based study [6]. In the study of Ding et al. [7], the time for patient enrollment varied from 1–6 months after acute stroke onset, with an average of 1.4 years during the follow-up period. Therefore, the present study cannot be compared to the previous studies, because of the following reasons: sources of stroke patients, time for enrollment, and follow-up period. In addition, the low mortality rate in the present study could be due to the high proportion of mild-stroke patients, which were 2/3 of patients enrolled were classified as lacunar infarction. The mortality rates of lacunar infarction within 1 month to 1 year after acute stroke onset were low. A meta-analysis by Jackson et al. [13] suggested that the fatality rate of patients with non-lacunar infarction is 3.8 times greater than lacunar infarction patients. The difference in patient mortality between non-lacunar infarction and lacunar infarction decreases by 2.3 times within 1–12 months after acute stroke onset, and the recurrent stroke rate is as low as 0–4% in lacunar infarction patients.

Results from the present study demonstrated that acute CVD event was a major cause of death in moderate and mild IS patients and accounted for 61%. The proportion of recurrent stroke was as high as 68% in all acute CVD death, while acute myocardial infarction and sudden ranged as the second and third causes of death. The proportion of recurrent stroke was high in new acute CVD events, and IS was the dominant stroke subtype in recurrence stroke events (84%). These proportions were similar to previous findings from several grade-III hospital-based registry studies [4-6] and the Northern Manhattan Study [14].

Hypertension, diabetes, dyslipidemia, obesity, and an unhealthy lifestyle are highly associated with initial stroke. The factors influencing recurrent stroke, acute CVD events, and death are more complicated in post-stroke patients than those without stroke. In general, vascular risk factors were clustered, and functional disability and depression symptoms were common in post-stroke patients. Previous studies have shown that functional disability and depression symptoms significantly directly or indirectly correlate with poor outcomes in post-stroke patients [15-17]. Baseline assessment showed that the prevalence of vascular risk factors were high in this patient group. Among all modified vascular risk factors, diabetes mellitus was an independent predictor of acute CVD events and recurrent stroke. The association between hypertension and recurrent stroke was weaker than with diabetes. In addition, ADL dependence was a strong predictor of death, although the proportion of ADL dependence was less than in several grade III hospital-based registry studies [4-6]. These findings suggested that management of vascular risk factors and rehabilitation were important for secondary and tertiary stroke prevention. In the newly released 2010 Guideline to Secondary Prevention for Ischemic Stroke and Transient Ischemic Attack by the Cerebrovascular Diseases Group of the Neurology Branch of the Chinese Medical Association [18], management of vascular risk factors received much attention, but the role of functional rehabilitation for improving stroke patient outcome was not mentioned. The strengths of the present study include a large number of enrolled patients, a long-term follow-up period lasting for 5 years, and a small number of patients lost to follow-up. The drop-out rate was 10% during the five-year follow-up period, which was significantly less than in grade-III hospital-based registry study [6]. However, there were no differences in baseline characteristics between patients followed and those lost. Weaknesses of the study included selection bias of stroke patients. The moderate or mild IS patients were enrolled from community hospitals, but patients with severe functional disability (more likely to go to rehabilitation hospital or nursing home) or completely recovered stroke patients were not enrolled. Nolte [19] showed that the ideal prospective study for stroke prognosis should focus on defined populations, allowing examination of patients representative of a broad range (severe and mild stroke). In addition, only patients diagnosed by neuro-imaging examination were enrolled to ensure correct diagnosis and stroke subtype classification. With a rapidly aging Chinese population, and an increased stroke incidence and reduced stroke mortality, the number of surviving stroke patients is likely to greatly increase in the future. In addition, stroke patients in community hospitals will accordingly increase, putting a burden on secondary and tertiary stroke prevention. To improve prognosis of stroke survivors, active management of vascular risk factors and rehabilitation are important. Results from the present study provide further information for community healthcare services, as well as policies for stroke prevention.

**SUBJECTS AND METHODS**

**Design**
A registry, cohort study.

**Time and setting**
Experiments were conducted from December 2003 to December 2008 in community hospitals in Beijing, China.

**Subjects**
In China, hospitals are classified into three grades: community hospitals are defined as grade I, hospitals that serve several communities are defined as grade II, and central hospitals for a certain district or city are defined as grade III and are typically teaching hospitals. High-tech equipment, such as computed tomography (CT)/magnetic resonance imaging (MRI), an intensive care unit, and neurology and neurosurgery departments are available in grade III.
and some grade II hospitals. Although there are physicians or family doctors in community hospitals, most are only available during normal working hours. Community hospitals are located within a community, which makes it easier for patients living in the community to reach. The majority of community hospitals provide treatment and management of patients with chronic diseases, such as hypertension, diabetes, coronary heart diseases, and stroke, as well as public health issues like vaccinations and family planning. Therefore, the flow for diagnosis, treatment, and stroke rehabilitation in urban area is as follows: grade II or III hospitals are in charge of diagnosis and early treatment/rehabilitation of acute stroke patients. At 14–30 days after acute stroke onset, the patients are typically discharged from grade I or grade II hospitals. Post-stroke patients with serious disabilities typically go to rehabilitation hospitals. Post-stroke patients, in particular those with moderate or mild stroke, go home and visit doctors in community hospitals for risk management and rehabilitation.

Five community hospitals were randomly selected from 300 community hospitals in the urban Beijing municipality. These five community hospitals were located in eastern, southern, western, northwestern, and northeastern urban Beijing, respectively. A total of 1 371 patients were admitted to these community hospitals and were consecutively recruited between December 2003 and December 2004.

Diagnostic criteria: according to criteria issued by world health organization, stroke is defined by appearance of sudden occurrence and rapidly aggravated local or global neurological impairment that lasts for > 24 hours (or the patient dies within 24 hours after onset), with no apparent non-vascular causes. Stroke includes cerebral infarction, cerebral hemorrhage, and subarachnoid hemorrhage. Stroke is diagnosed by CT or MRI examinations, and IS is classified into atherothrombotic cerebral infarction, cerebral embolism, and lacunar infarction.

**Inclusive criteria**
(1) Patients with symptomatic IS; (2) 3 months after first attack of acute stroke; (3) patients provided informed consent for the study.

**Exclusion criteria**
(1) Patients with silent brain infarction or coma (but with no symptom or signs leading to IS diagnosis by imaging examinations); (2) within 3 months after acute stroke onset; (3) patient rejected to take part in the study.

Of the 1 371 patients, 1 308 were IS and 63 were hemorrhage stroke, respectively. Of 1 308 IS cases (including lacunar infarction, cerebral embolism, and cerebral thrombosis), 1 174 cases met criteria for study enrollment, but 86 cases did not sign the consent form. There were 1 088 cases enrolled and 710 cases were first-ever stroke. Only prognosis and determinants related to poor outcomes were evaluated for first-ever stroke patients.

**Methods**

**Collection of baseline information**
All patients were surveyed by a self-designed questionnaire for general information and disease conditions before and after stroke. The patients also underwent physical health examinations and laboratory tests. All surveys were conducted by trained medical staff from the community.

**Clinical assessment**
All enrolled patients underwent a standardized assessment by a multidisciplinary stroke care research team, including physicians, neurologists, epidemiologists, and nurses. The assessment questionnaire included gathering information on demographic characteristics, as follows:
(1) General information: age, gender, educational years, and marriage status.
(2) Personal history: smoking and drinking (characterized as never, current, or quit).
(3) Current disease history: date of stroke onset and stroke subtype.
(4) Past disease history: frequency and time of stroke onset, history of hypertension, diabetes mellitus, and dyslipidemia, as well as duration, type, treatment, and drugs for the above diseases.
(5) ADL: disability was assessed according to the Barthel Index (BI) scale. BI evaluates basic daily activities for self-care (feeding, grooming, dressing, toileting, bathing, and continence of bowel and bladder) and mobility (transferring, walking, and stair climbing) on a total score from 0 (totally ADL dependent) to 100 (totally ADL independent) functioning.
(6) Depression: depressive symptoms were assessed according to a self-rating depression scale. The scale was a 20-item, self-reported index of frequency of experienced depressive symptoms within one week. Cutoff scores for the scale were as follows: < 50 (normal), 50 to 59 (mild), 60 to 69 (moderate), and > 69 (severe).

All depression scales were administered by research nurses trained by a psychiatrist specialized in the assessment and management of post-stroke mood disorders.

**Physical health examination and laboratory tests**
Physical health examination included height, body mass, and blood pressure measurements. Laboratory tests required the collection of fasting venous blood samples in the morning after 12 hours’ fasting, and the items included fasting blood glucose, total cholesterol, triglyceride, high-density lipoproteins cholesterol, and low-density lipoproteins cholesterol.

**Follow-ups**
Follow-up information was obtained by direct contact or from the family doctors every 6 months until December 2008. If patients were not reached at the follow-up, the family doctors would attempt to contact relatives to collect information on patient condition. Recurrent stroke, CVD events, and death were monitored during the follow-up examinations. The number of patients lost...
Study endpoints

Study endpoint information was collected at each visit, which included the all-causes death, acute CVD events (acute myocardial infarction and sudden death), and recurrence stroke (stroke continued to appear within 28 days after initial attack of acute stroke). Events of recurrent stroke and acute myocardial infarction were based on diagnosis and discharge summary according from the patient’s physicians, and the cause of death was based on medical records and death certificates.

Definitions

Stroke is defined by World Health Organization criterion as “rapidly developing clinical signs of focal (or global) disturbance of cerebral function lasting more than 24 hours (unless interrupted by surgery or death) with no apparent cause other than of vascular origin”. Stroke diagnosis was performed by neurologists and neurosurgeons based on clinical symptoms, physical signs, and neuroimaging examination. Recurrent stroke was defined as a new neurological deficit occurring in a vascular region and lasting more than 24 hours. Risk factors were defined as follows: hypertension (systolic blood pressure ≥ 140 mm Hg (1 mm Hg = 0.133 kPa), diastolic blood pressure ≥ 90 mm Hg, patient self-report of hypertension, or use of anti-hypertension drugs within the past two weeks), cardiac disease (history of myocardial infarction, coronary artery disease, congestive heart failure, arrhythmia, or valvular heart disease), diabetes mellitus (fasting blood glucose level ≥ 7.0 mM, patient’s self-report of diabetes, or use of anti-diabetic drugs), dyslipidemia (fasting total cholesterol ≥ 5.72 mM, low-density lipoprotein ≥ 3.64 mM, high-density lipoprotein ≥ 0.91 mM, triglyceride ≥ 1.70 mM, patient self-report history of hyperlipidemia, or use of anti-hyperlipidemic drugs). Body mass index was calculated according to the following formula: body weight (kg)/body height (m)^2.

Statistical analysis

Data were recorded using Epidata (Center for Disease Control and Prevention, Atlanta, Georgia, USA), and were corrected and statistically analyzed using SPSS 16.0 (SPSS, Chicago, IL, USA). Mean values and rates were compared with t-test, analysis of variance, and chi-square test. Cox proportional hazards models were utilized for multiple factor analysis. HR, 95% CI, and probability value were calculated.

Acknowledgments: We wish to thank the patients and their families, as well as the involved healthcare professionals. We wish to give special thanks to Dr. Lijuan Mu and Dr. Songlin Jing from the Association of Beijing Community Healthcare for help with administration, quality control, and data collection.

Funding: This study was supported by the National Natural Science Foundation of China, No. 30671797 and 81072361.

Author contributions: Xianghua Fang conceived and designed the study, was responsible for funds, performed statistical analysis, and wrote and revised the manuscript. Liming Li and Xinqiu Zhang supervised and provided important assessment of study design, as well administrative support. Hongjun Liu, Hongmei Zhang, and Xiaoming Qin were responsible for on-site surveys and quality control work.

Conflicts of interest: None declared.

REFERENCES

[1] Petty GW, Brown RD Jr, Whisnant JP, et al. Ischemic stroke subtypes: a population-based study of functional outcome, survival, and recurrence. Stroke. 2000;31(5):1062-1068.
[2] Hankey GJ, Jamrozik K, Broadhurst RJ, et al. Five-year survival after first-ever stroke and related prognostic factors in the Perth Community Stroke Study. Stroke. 2000;31(9):2080-2086.
[3] Jiang B, Wang WZ, Chen H, et al. Incidence and trends of stroke and its subtypes in China: results from three large cities. Stroke. 2006;37(1):83-96.
[4] Liu X, Xu G, Wu W, et al. Subtypes and one-year survival of first-ever stroke in Chinese patients: The Nanjing Stroke Registry. Cerebrovasc Dis. 2006;22(2-3):130-136.
[5] Wu B, Lin S, Hao Z, et al. Proportion, risk factors and outcome of lacunar infarction: a hospital-based study in a Chinese population. Cerebrovasc Dis. 2010;29(2):181-187.
[6] Ding D, Lu CZ, Fu JH, et al. Predictors of vascular events after ischemic stroke: the China ischemic stroke registry study. Neuroepidemiology. 2010;34(2):110-116.
[7] 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(4):355-361.
[8] Kiyohara Y, Kubo M, Kato I, et al. Ten-year prognosis of stroke and risk factors for death in a Japanese community: the Hisayama stroke study. Stroke. 2003;34(10):2343-2347.
[9] Nolle G, D’Aniello AM, Muscherà R, et al. The aftermath of rehabilitation for patients with severe stroke. Acta Neurol Scand. 2003;107(4):281-284.
[10] Minister of Health. Acts for Hospital Classification. China: Minister of Health. 1989.
[11] Tang Z, Fang XH, Ping GY, et al. Research on the health care of the elderly in Beijing. Jiefangjun Yiyou Guanli Zazhi. 2004;20:464-469.
[12] Wang X, Jiang G, Wang D, et al. All-cause mortality in Tianjin, China, 1999-2004. Prev Chronic Dis. 2009;6(4):A132.
[13] Jackson C, Sudlow C. Comparing risks of death and recurrent vascular events between lacunar and non-lacunar infarction. Brain. 2005;128(Pt 11):2507-2517.
[14] Dhamoon MS, Sciacca RR, Rundek T, et al. Recurrent stroke and cardiac risks after first ischemic stroke: the Northern Manhattan Study. Neurology. 2006;66(5):641-646.
[15] Thorgren M, Westling B, Norving B. Outcome after stroke in patients discharged to independent living. Stroke. 1990;21(2):236-240.
[16] Hankey GJ, Jamrozik K, Broadhurst RJ, et al. Long-term disability after first-ever stroke and related prognostic factors in the Perth Community Stroke Study. 1989-1990. Stroke. 2002;33(4):1034-1040.
[17] Parikh RM, Robinson RG, Lispesy JR, et al. The impact of poststroke depression on recovery in activities of daily living over a 2-year follow-up. Arch Neurol. 1990;47(7):785-789.
[18] The Cerebrovascular Disease Group of the Neurology Branch of the Chinese Medical Association. 2010 Guideline to Secondary Prevention for Ischemic Stroke and Transient Ischemic Attack in China. Chin J Neurol. 2010;43:154-160.
[19] Nolle G. Editorial comment--Trends in stroke mortality. Stroke. 2003;34(10):2347-2348.

(Edited by Xiao N, Yang XB/Yang Y/Wang L)