Prevalence, Incidence, and Mortality of Stroke in China

Results from a Nationwide Population-Based Survey of 480 687 Adults

BACKGROUND: China bears the biggest stroke burden in the world. However, little is known about the current prevalence, incidence, and mortality of stroke at the national level, and the trend in the past 30 years.

METHODS: In 2013, a nationally representative door-to-door survey was conducted in 155 urban and rural centers in 31 provinces in China, totaling 480 687 adults aged ≥20 years. All stroke survivors were considered as prevalent stroke cases at the prevalent time (August 31, 2013). First-ever strokes that occurred during 1 year preceding the survey point-prevalent time were considered as incident cases. According to computed tomography/MRI/autopsy findings, strokes were categorized into ischemic stroke, intracerebral hemorrhage, subarachnoid hemorrhage, and stroke of undetermined type.

RESULTS: Of 480 687 participants, 7672 were diagnosed with a prevalent stroke (1596.0/100 000 people) and 1643 with incident strokes (345.1/100 000 person-years). The age-standardized prevalence, incidence, and mortality rates were 1114.8/100 000 people, 246.8 and 114.8/100 000 person-years, respectively. Pathological type of stroke was documented by computed tomography/MRI brain scanning in 90% of prevalent and 83% of incident stroke cases. Among incident and prevalent strokes, ischemic stroke constituted 69.6% and 77.8%, intracerebral hemorrhage 23.8% and 15.8%, subarachnoid hemorrhage 4.4% and 4.4%, and undetermined type 2.1% and 2.0%, respectively. Age-specific stroke prevalence in men aged ≥40 years was significantly greater than the prevalence in women (P<0.001). The most prevalent risk factors among stroke survivors were hypertension (88%), smoking (48%), and alcohol use (44%). Stroke prevalence estimates in 2013 were statistically greater than those reported in China 3 decades ago, especially among rural residents (P=0.017). The highest annual incidence and mortality of stroke was in Northeast (365 and 159/100 000 person-years), then Central areas (326 and 154/100 000 person-years), and the lowest incidence was in Southwest China (154/100 000 person-years), and the lowest mortality was in South China (65/100 000 person-years) (P<0.002).

CONCLUSIONS: Stroke burden in China has increased over the past 30 years, and remains particularly high in rural areas. There is a north-to-south gradient in stroke in China, with the greatest stroke burden observed in the northern and central regions.

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Clinical Perspective

What Is New?

- The population-based large-scale national stroke survey demonstrated that stroke burden in China has increased over the past 30 years, and remains particularly high in rural areas, and that there is a north-to-south gradient in stroke in China, with the greatest stroke burden observed in the northern and central regions.

What Are the Clinical Implications?

- The study estimates allow evidence-based healthcare planning for stroke patients in all major regions of China (eg, number of hospital beds, stroke units, acute care and rehabilitation staff), with priority setting for stroke care (eg, the need for greater resources required for northern and central regions of China, especially rural areas) and prevention (eg, emphasis on blood pressure control).

Stroke is the third most common cause of death in most Western countries, after coronary heart disease and cancer,[1,2] but it has been the leading cause of death in China in recent years,[3,4]constituting almost one-third of the total number of deaths from stroke worldwide.[2] By 2013, 27 of 33 provinces in China had stroke as the leading cause of death.[5] However, previous studies of stroke epidemiology in China were either not population based, or of limited scope and diagnostic accuracy (eg, confined to the age group between 25 and 74 years, lacked neuroimaging verification of pathological type of stroke, suffered from selection bias or were based on small, not nationally representative sample sizes), and most of them were conducted 20 to 30 years ago.[6–10] In addition, in the past 2 decades, China has experienced rapid health transitions and sociodemographic changes[5,11] that have had an impact on the prevalence of common stroke risk factors.[11] For example, there was a large increase in the prevalence of hypertension, smoking, overweight, and diabetes mellitus, all of which might have affected stroke burden in China.[11–18] Therefore, obtaining more up-to-date and accurate estimates of stroke burden (as measured by incidence, prevalence, and mortality) and its secular trend across China is crucial for evidence-based and region-specific planning and evaluation of the effectiveness of the currently implemented treatment and prevention strategies. The goal of this national epidemiological survey of stroke in China (NESS-China) was to identify the true stroke burden (incidence, prevalence, and mortality) in men and women of ≥20 years of age across all major regions of China in 2012 to 2013.

METHODS

Study Population and Design

This study was based on the National Disease Surveillance Points System, which represents the national geographical distribution, social and economic status, and population age and sex in China. The survey was conducted in 157 Disease Surveillance Points across all 7 major regions of China including 64 urban and 93 rural areas (online-only Data Supplement Figure I). We defined all the survey districts in cities (large, middle, or small cities) as the urban regions, and the other rural survey sites (engaged in agricultural labor) as the rural regions. In China, there are a lot of differences for those residents who live in urban areas in comparison with the residents living in rural areas. These differences include socioeconomic conditions, education level, environmental conditions, medical care, and lifestyles. In the first stage of sampling, 1 town/district proportional to the population size of that area was selected in each of the 157 survey sites. In the next stage, in each selected location, ≥1 urban communities/villages with a total population of at least 4500 residents (≈1500 households) were selected by using the random sampling method. The selected urban communities/villages in each town/district may have come from several different communities/villages adjacent to each other. All people who lived in the selected households and met our inclusion criteria were interviewed.

The study was designed as a door-to-door survey, and participants were people who had lived in that county (or district) for at least 6 months. Interviewers were required to have face-to-face meetings with all identified participants during the survey, and a response rate of 80% was expected. The point-prevalence day was determined as August 31, 2013. The survey consisted of 2 stages of face-to-face interviews/screenings. During the first stage, all eligible study participants were initially screened by the Chinese Center for Disease Control and Prevention researchers for a history of stroke. The validated verbal autopsy technique[19–21] was used for members of the households who died during the 12 months preceding the survey, to identify stroke as a possible cause of death. At the second stage, study neurologists ascertained all study participants (including deceased ones) identified with stroke or suspected stroke to confirm or refute the diagnosis. The organization and coordination of both stages of the survey were performed provincial and local Center for Disease Control and Prevention. The specific details of survey procedures were as follows (online-only Data Supplement Figure II):

Preliminary Screening by the Center for Disease Control and Prevention Investigators

From September 1 to December 31, 2013, Center for Disease Control and Prevention investigators visited each household and collected the informed consent forms and completed preliminary screening form signed by the study participants. This questionnaire included basic information about their family members, symptoms, and medical history of the individuals, and family members who died of stroke or presumed stroke between September 1, 2012, and August 31, 2013, according to the validated methodology for estimating population-based incidence and mortality rates from a large door-to-door survey,[22,23] which has also been validated and used in China.[6–8,21] After the preliminary screening, participants with

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the symptoms or history suggestive of stroke were invited to see a neurologist in the town/village clinic of their choice. Their medical records (eg, cardiovascular disease risk factors, computed head tomography (CT) and MRI scans, autopsy protocols) were carefully reviewed and relevant data recorded. When appropriate, some study participants were requested to have a brain-neuroimaging examination (eg, to exclude brain disorders mimicking stroke) and another neurological examination.

Review/Confirmation by Neurologists

At this stage of the survey, neurologists interviewed 28 506 participants with suspected stroke/transient ischemic attack (including all definite and possible cases) and completed the case adjudication forms. The neurological examination and review were completed in 97.4% of the eligible cases. Of all these study participants, 766 patients refused to be interviewed or were lost to follow-up (online-only Data Supplement Figure I). If participants died during the follow-up, the neurologists reviewed all available data/documentation and decided on the diagnosis of stroke. All subjects with confirmed first-ever stroke (either fatal or nonfatal) between September 1, 2012, and August 31, 2013, were considered as having an incident stroke (fatal cases of incident strokes were used to estimate stroke mortality rates). To enhance the accuracy of the self-reported stroke event dates, all dates reported by the study participants were cross-checked against medical records of the people concerned, including official statistics and death certificates (for fatal events). All alive subjects with confirmed stroke by August 31, 2013, were considered as having a prevalent stroke.

Diagnostic Criteria

Based on the World Health Organization criteria, stroke was defined as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin."[24] Any nervous system abnormalities induced by trauma, metabolic disorder, tumor, or central nervous system infections were excluded. Whenever brain imaging was used within the first week of stroke onset and the results of the imaging or autopsy protocol for deceased subjects were available for reviewing by the study neurologist, pathological type of stroke was classified into 4 major categories: subarachnoid hemorrhage (SAH; lumbar puncture was allowed for diagnosing SAH only); intracerebral hemorrhage (ICH); and ischemic stroke (IS). Stroke cases with no brain imaging done within the first week of stroke onset, or when the results of the imaging or autopsy were not available for reviewing by the study neurologist, were classified as stroke of undetermined pathological type.

Self-reported information on education, marital status, and current occupation was used. History of hypertension or diabetes mellitus was defined by patients' self-report of having being told by a doctor that they had high blood pressure (or documented systolic blood pressure ≥140 mm Hg or diastolic blood pressure ≥90 mm Hg) or diabetes mellitus, or by the use of blood pressure–lowering or antidiabetic drugs, respectively. Atrial fibrillation was diagnosed by ECG, as per medical records. The diagnosis of coronary heart disease (CHD) included history of myocardial infarction or angina documented by medical records. Dyslipidemia was diagnosed by medical records. Current smoking (≥1 cigarette per day) and alcohol intake (any dose of alcohol, ≥1 time per week) were defined by subjects' self-report.

Data Collection

All questionnaires were sent to Beijing Neurosurgical Institute before the end of 2013, where they were reviewed by the research staff and then entered into a database by specialized staff according to the standard procedure. All research staff were given standardized training and formally certified before taking part in the data collection. Each survey site had a professional quality controller to verify and monitor the quality and completeness of questionnaires and to ensure the adherence to the standardized study protocol. During the data collection and cleaning process, a strict double-entry system was adopted for quality control. The Clinical Research Organization monitored the whole process during the survey period to ensure the consistency of data collection across all study sites. Two of the 157 survey sites did not meet the requirements of the study design and were therefore excluded from the final data analysis. The study was approved by the ethical review committees of Beijing Tiantan Hospital and of all other participating institutes. Written informed consent was obtained from all study participants by interviewers before data collection began.

Sample Size Estimates and Statistical Analysis

To ensure that the subjects had national representation on socioeconomic status, age, sex, and geographical location, a multistage stratified cluster-sampling method was applied, based on the national census of 2010. The sample size was calculated by using the formula:

$$N = deff\,\frac{u^2 p(1-p)}{d^2}$$

Means and 95% confidence interval (CI; 2-sided for u=1.96) were determined; the prevalence of stroke (1%) obtained in the China Non-communicable Disease Surveillance 2010 was used as a measure of probability (p); the design effect (*deff*) value was set at 5; and the relative error was: d=r×1%, r=15%. Based on these parameters, the sample size for each stratum was estimated to be 84 516 subjects. Because there were 6 strata, and assuming a potential nonresponse rate of 15%, the sample size of all ages was calculated as 596 578 (≈600 000 subjects). Sample weighting was used to account for different proportions of age (10-year groups from 20 to 79, then ≥80 years), sex, urban or rural residence, and geographic regions.

Prevalence (per 100 000 people), incidence and mortality rates (per 100 000 people per year) were estimated by age and sex. Crude and age-standardized prevalence and annual incidence and mortality rates (direct method of standardization by using China census 2010 as a standard) were calculated together with 95% CIs by using Poisson distribution. Descriptive statistics were used to assess differences between men and women and between rural and urban populations: differences in the distribution of categorical variables were tested by the Cochrane-Armitage method. Calculation of weight coefficients were considered for sampling weights, nonresponse weights, and poststratification weights. Poststratification weights that adjusted for age, rural/urban residence, and geographic location in accordance with 2010 China census data were considered. All statistical analyses were conducted by using SAS version 9.4 (SAS Institute Inc).

RESULTS

The characteristics of the study participants are shown in Table 1. The response rate was 81%. The mean age of the participants was 46.6 (standard deviation [SD] 16.3) years; approximately one-third (35.1%) had only a primary school education or less; 81.0% were married or had a partner; the majority were farmers (54.1%); and 42.9% resided in an urban area. The sociodemographic characteristics of the study participants were similar to those of China as a whole. A total of 6616 people (86.2%) with prevalent stroke and 1283 people with incident stroke (78.1%) were hospitalized for their stroke within 7 days of stroke onset. Pathological type of stroke was verified by CT/MRI/autopsy findings in 90.3% and 82.5% of prevalent and incident stroke cases, respectively.

Of the 480 687 study participants, 7672 (4217 men [55.0%], 3455 women) were considered as having had a stroke as at the prevalence date. The mean age of people with prevalent stroke was 66.4 (SD 10.6) years: 66.2 (SD 10.6) years in men and 66.6 (SD 10.5) years in women. The crude prevalence of stroke (Table 2) was 1596.0/100 000 people (95% CI, 1560.6–1631.5). Although the age-standardized prevalence of stroke did not differ significantly between men and women (1222.2/100 000 [95% CI, 1094.8–1349.5]) and (1005.7/100 000 [95% CI, 884.2–1127.1], respectively), the age-specific prevalence of stroke was markedly higher among men than among women across all age groups except for those aged 20 to 39 years. The age-specific prevalence of stroke and all pathological types of stroke increased with increasing age in both men and women, with a particularly marked increase in those ≥50

Table 1. Characteristics of the Study Participants (≥20 Years) in 2013

Characteristics	Overall	Men	Women	*P* Value
Participants, n (%)	480 687 (100.0)	238 427 (49.6)	242 260 (50.4)	
Residence (urban, n (%)	231 554 (48.2)	112 893 (47.4)	118 661 (49.0)	<0.001
Age groups, n (%)				
20–29	92 385 (19.2)	45 405 (19.0)	46 980 (19.4)	<0.001
30–39	87 965 (18.3)	44 446 (18.6)	43 519 (18.0)	
40–49	108 792 (22.6)	54 973 (23.1)	53 819 (22.2)	
50–59	83 151 (17.3)	41 294 (17.3)	41 857 (17.3)	
60–69	62 900 (13.1)	30 577 (12.8)	32 323 (13.3)	
70–79	33 476 (7.0)	16 290 (6.8)	17 186 (7.1)	
≥80	12 018 (2.5)	5442 (2.3)	6576 (2.7)	
Education, n (%)				
Primary school or lower	168 606 (35.1)	73 115 (30.7)	95 491 (39.4)	<0.001
Middle school	260 154 (54.1)	138 356 (58.0)	121 798 (50.3)	
College and higher	49 254 (10.3)	25 693 (10.8)	23 561 (9.7)	
Missing	2673 (0.6)	1263 (0.5)	1410 (0.6)	
Marital status, n (%)				
Married	389 118 (81.0)	192 628 (80.8)	196 490 (81.1)	<0.001
Single	55 434 (11.5)	32 886 (13.8)	22 548 (9.3)	
Widowed	32 501 (6.8)	11 111 (4.7)	21 390 (8.8)	
Missing	3634 (0.8)	1802 (0.8)	1832 (0.8)	
Occupation, n (%)				
Students	10 398 (2.2)	4905 (2.1)	5493 (2.3)	<0.001
Worker	43 567 (9.1)	24 935 (10.5)	18 632 (7.7)	
Farmer	259 967 (54.1)	130 013 (54.5)	129 954 (53.6)	
Employee	45 762 (9.5)	25 034 (10.5)	20 728 (8.6)	
Entrepreneurs	50 494 (10.5)	26 878 (11.3)	23 616 (9.8)	
Retired or unemployed	65 331 (13.6)	23 699 (9.9)	41 632 (17.2)	
Missing	5168 (1.1)	2963 (1.2)	2205 (0.9)	

Table 2. Prevalence of Stroke per 100 000 (With 95% CI) Chinese Adults by Sex in 2013

Age Group, y	Men			Women			Total		
	No. of Strokes	Rate	95% CI	No. of Strokes	Rate	95% CI	No. of Strokes	Rate	95% CI
20–29	7	15.4	(4.0–26.8)	8	17.0	(5.2–28.8)	15	16.2	(8.0–24.5)
30–39	35	78.7	(52.7–104.8)	25	57.4	(34.9–80.0)	60	68.2	(51.0–85.5)
40–49	247	449.3	(393.4–505.2)	178	330.7	(282.2–379.2)	425	390.7	(353.6–427.7)
50–59	862	2087.5	(1949.6–2225.4)	680	1624.6	(1503.5–1745.7)	1542	1854.5	(1762.8–1946.2)
60–69	1441	4712.7	(4475.2–4950.2)	1238	3830.1	(3620.9–4039.3)	2679	4259.1	(4101.3–4417.0)
70–79	1223	7507.7	(7103.0–7912.3)	1010	5876.9	(5525.2–6228.5)	2233	6670.5	(6403.2–6937.7)
≥80	402	7387.0	(6692.1–8081.9)	316	4805.4	(4288.4–5322.3)	718	5974.4	(5550.6–6398.1)
Total	4217	1768.7	(1715.8–1821.6)	3455	1426.2	(1378.9–1473.4)	7672	1596.0	(1560.6–1631.5)
ASR		1222.2	(1094.8–1349.5)		1005.7	(884.2–1127.1)		1114.8	(996.5–1233.1)

ASR indicates the age-standardized rates to China census population 2010; and CI, confidence interval.

years (Table 2; online-only Data Supplement Table I; online-only Data Supplement Figure III). Among the risk factors analyzed (Table 3), the most prevalent risk factors in stroke survivors were hypertension (84.2%), smoking (47.6%), and drinking alcohol (43.9%). The least prevalent were atrial fibrillation (2.7%) and CHD (16.8%). The prevalence of diabetes mellitus, dyslipidemia, atrial fibrillation, and CHD was significantly greater in women than in men, but the prevalence of alcohol drinking and smoking was significantly greater in men. Although there was no significant difference in the prevalence of hypertension, alcohol drinking, and smoking between urban and rural subjects, diabetes mellitus, dyslipidemia, atrial fibrillation, and CHD were more prevalent among urban subjects.

There were 1643 incident strokes (55.0% in men) identified over the 12-month period, of which IS constituted 1144 (69.6%), ICH constituted 391 (23.8%), SAH constituted 73 (4.4%), and stroke of undetermined pathological type constituted 35 (2.1%). The mean age of people with incident stroke was 66.4 (SD 12.04) years: 65.5 (SD 11.95) years in men and 67.6 (SD 12.05) years in women. The overall crude incidence of first-ever stroke (Table 4) was 345.1 (95% CI, 328.4–361.7) per 100 000 person-years. Although the incidence of stroke overall and of all stroke pathological types was numerically higher in men than in women across all age groups (Table 4; online-only Data Supplement Table II; online-only Data Supplement Figure IV), these differences did not reach a statistically significant level (except those aged 50–59 for stroke overall and IS) and there were no statistically significant sex differences in the age-standardized incidence rates. Stroke incidence in rural residents (298.2/100 000) was significantly greater than in urban residents (203.6/100 000). Among pathological types of stroke (online-only Data Supplement Table II), incidence rates were highest for IS (166.9/100 000), followed by ICH (66.2/100 000) and SAH (9.8/100 000). The age-specific incidence of total stroke and the 3 major pathological types of stroke (IS, ICH, and SAH) increased with increasing of age in both men and women (online-only Data Supplement Figure IV).

The overall crude stroke mortality rate was 159.2 (95% CI, 147.9–170.5) per 100 000 person-years (Table 5). The age-standardized mortality did not differ statistically significantly between men (122.0/100 000 [95% CI, 99.0–145.0]) and women (107.5 [95% CI, 85.3–129.7]), but in people aged ≥60, the age-specific mortality rates of stroke in men were statistically significantly greater than those in women. The age-specific mortality of stroke increased with increasing of age. The prevalence, incidence, and mortality rates of stroke were significantly higher in rural areas than in urban areas (Figure 1). Furthermore, rural versus urban areas experienced greater increases in stroke burden as evident by a comparison of estimates obtained in 1985 with those of the current study (online-only Data Supplement Figure V).

Of the 7 major geographic regions of China (Northeast, North China, East China, South China, Southwest, Northwest, and Central China) (Figure 2), the highest age-standardized prevalence (online-only Data Supplement Figure III) was observed in Central China (1549.5/100 000); Northeast was ranked the second (1450.3/100 000), and the lowest prevalence (624.5/100 000) was in South China ($P<0.001$). The highest incidence and mortality of stroke was in the Northeast region (365.2/100 000 person-years and 158.5/100 000 person-years, respectively), the next highest rates were in Central China (326.1/100 000 and 153.7/100 000), and the regions with lowest incidence and mortality rates were in South China (154.6/100 000 and 65.0/100 000, respectively) ($P<0.002$). There were statistically significant differences in the prevalence of

Table 3. Prevalence of Some Risk Factors in 7672 People With Prevalent Stroke by Sex and Residency in China

	Sex			Urban and Rural			
	Men n (%)	Women n (%)	*P* Value	Urban n (%)	Rural n (%)	Total n (%)	*P* Value
Hypertension							
Yes	3530 (83.71)	2933 (84.89)	0.247	2980 (84.42)	3483 (84.09)	6463 (84.24)	0.385
No	476 (11.29)	349 (10.10)		386 (10.93)	439 (10.60)	825 (10.75)	
Missed	211 (5.00)	173 (5.01)		164 (4.65)	220 (5.31)	384 (5.01)	
Diabetes mellitus							
Yes	539 (12.78)	549 (15.89)	<0.001	618 (17.51)	470 (11.35)	1088 (14.18)	<0.001
No	3232 (76.64)	2556 (73.98)		2647 (74.99)	3141 (75.83)	5788 (75.44)	
Missed	446 (10.58)	350 (10.13)		265 (7.51)	531 (12.82)	796 (10.38)	
Dyslipidemia							
Yes	870 (20.63)	801 (23.18)	0.025	956 (27.08)	715 (17.26)	1671 (21.78)	<0.001
No	2222 (52.69)	1751 (50.68)		1898 (53.77)	2075 (50.10)	3973 (51.79)	
Missed	1125 (26.68)	903 (26.14)		676 (19.15)	1352 (32.64)	2028 (26.43)	
Atrial fibrillation							
Yes	99 (2.35)	106 (3.07)	0.002	123 (3.48)	82 (1.98)	205 (2.67)	<0.001
No	3602 (85.42)	2852 (82.55)		3062 (86.74)	3392 (81.89)	6454 (84.12)	
Missed	516 (12.24)	497 (14.38)		345 (9.77)	668 (16.13)	1013 (13.20)	
CHD							
Yes	628 (14.89)	660 (19.10)	<0.001	710 (20.11)	578 (13.95)	1288 (16.79)	<0.001
No	3030 (71.85)	2311 (66.89)		2433 (68.92)	2908 (70.21)	5341 (69.62)	
Missed	559 (13.26)	484 (14.01)		387 (10.96)	656 (15.84)	1043 (13.59)	
Current smoker							
Yes	3048 (72.28)	606 (17.54)	<0.001	1656 (46.91)	1998 (48.24)	3654 (47.63)	0.495
No	996 (23.62)	2713 (78.52)		1732 (49.07)	1977 (47.73)	3709 (48.34)	
Missed	173 (4.10)	136 (3.94)		142 (4.02)	167 (4.03)	309 (4.03)	
Alcohol drinking							
Yes	2769 (65.66)	602 (17.42)	<0.001	1569 (44.45)	1802 (43.51)	3371 (43.94)	0.699
No	1276 (30.26)	2717 (78.64)		1822 (51.61)	2171 (52.41)	3993 (52.05)	
Missed	172 (4.08)	136 (3.94)		139 (3.94)	169 (4.08)	308 (4.01)	

CHD indicates coronary heart disease.

risk factors between the regions (online-only Data Supplement Table III). The prevalence of hypertension was highest in Northwest China (88.7%), followed by East China (88.1%), Central China (87.6%), and Northeast (85.6%). Diabetes mellitus prevalence was particularly high in South China (18.0%) and lowest in Southwest China (9.8%). The prevalence of dyslipidemia was highest in Central areas (27.5%) and lowest in Southwest (12.0%). The prevalence of atrial fibrillation was highest in South China and lowest in Southwest (1.5%). CHD prevalence was highest in Northeast (25.9%) and lowest in Southwest (3.50%). Alcohol drinking and smoking were most prevalent in Northeast (52.2% and 56.6% respectively) and lowest in the Northwest for alcohol (35.1%) and East China for smoking (42.9%).

DISCUSSION

Our study provides contemporary population-based estimates of the burden of stroke in China. The age-standardized prevalence, incidence, and mortality rates for stroke in China in 2012 to 2013 were 1115/100 000 (95% CI, 997–1233), 247/100 000 (95% CI, 211–283), and 115/100 000 (95% CI, 96–133), respectively. In comparison with a previous survey in 1985, the incidence and prevalence of stroke has increased in China.

Table 4. Incidence Rates (With 95% CI) of Stroke per 100 000 Person-Years of Chinese Adults (≥20 Years) by Sex in 2012 to 2013

Age Group, y	Men			Women			Total		
	No. of Strokes	Rate	95% CI	No. of Strokes	Rate	95% CI	No. of Strokes	Rate	95% CI
20–29	2	4.4	(0.0–10.4)	1	2.1	(0.0–6.2)	3	3.2	(0.0–6.8)
30–39	12	26.4	(11.5–41.3)	8	18.0	(5.5–30.5)	20	22.2	(12.5–32.0)
40–49	78	139.1	(108.3–170.0)	51	92.7	(67.3–118.1)	129	116.1	(96.1–136.1)
50–59	207	528.5	(456.7–600.3)	136	339.9	(282.8–396.9)	343	433.1	(387.4–478.9)
60–69	264	908.6	(799.5–1017.7)	224	738.0	(641.7–834.3)	488	821.4	(748.9–894.0)
70–79	234	1486.9	(1297.8–1676.0)	202	1219.7	(1052.6–1386.9)	436	1349.9	(1224.1–1475.8)
≥80	106	2216.6	(1799.4–2633.9)	118	1998.0	(1641.1–2354.8)	224	2095.8	(1824.2–2367.4)
Total	903	382.2	(357.3–407.0)	740	308.5	(286.3–330.7)	1643	345.1	(328.4–361.7)
ASR		266.4	(226.7–306.1)		226.9	(187.5–266.3)		246.8	(211.2–282.5)

ASR indicates age-standardized rates to China census population 2010; and CI, confidence interval.

The burden of stroke in China is substantial and our estimates when applied to the whole population suggest that there are ≈2.4 million new strokes and 1.1 million stroke-related deaths annually, with 11.1 million stroke survivors alive at any given time. We also found that there are gradients of stroke burden within China, both geographically (North to South) and in rural in comparison with urban areas, as well.

The current stroke prevalence (1115/100 000 [95% CI, 997–1233]) in China appears to be the highest among other low- to middle-income countries (range from 536 to 1040/100 000),[25–29] but significantly lower than that observed in high-income countries (range from 2600 to 8000/100 000).[30–32] In comparison with other similar population-based surveys, the current stroke incidence (247/100 000 person-years [95% CI, 211–283]) and mortality rates (115/100 000 person-years) in China appear to be the highest in the world (in 2 recent overviews, pooled stroke incidence and mortality rates varied between 85 and 117/100 000 person-years[33] and 30 and 114/100 000 person-years,[34] respectively). Stroke incidence rates observed in the current study were greater than in previous comparable surveys in China where these rates varied between 76 and 205/100 000 person-years,[6,8,35] suggesting a noticeable increase of stroke incidence in China over the past 3 decades. Although there were differences in the methodologies between this and previous stroke surveys in China, a similar increase in stroke incidence and prevalence rates in other developing countries over the past 3 decades[2,33] suggests that the observed increase in stroke incidence and prevalence rates in China is real. Previous reports have shown that stroke incidence in China, and particularly incidence of ICH, was greater than in other countries.[2,36]

The burden of stroke in China appears to be increasing particularly in rural areas. In a study conducted among rural residents of China in 1985,[8] the age-standardized prevalence of stroke in all ages was 365/100 000 individuals; in the current study, it was 930/100 000 (age-standardized by World Health Organization world population) in rural areas, demonstrating a 2.5-fold increase (online-only Data Supplement Figure V) over the past 3 decades. However, the prevalence of diabetes mellitus, dyslipidemia, atrial fibrillation, and CHD appeared to be greater in the urban versus rural areas (Table 3). The observed diverging trends in stroke incidence rates between rural and urban Chinese populations may be associated with the quality of stroke primary prevention in these areas (positive trends in urban and negative trends and poorer management of risk factors in rural areas of China). The higher stroke incidence in rural residents of China may also be related to their lower socioeconomic status in comparison with urban residents.[37] It is also possible that stroke awareness in rural areas of China is less than in urban areas; therefore, rural people who develop transient ischemic attacks do not seek medical attention until their transient ischemic attacks result in stroke, whereas urban residents with transient ischemic attacks seek earlier medical attention and do not progress to stroke.

The observed stroke mortality rates in China in 2013 were lower than those observed in China in 1985 (online-only Data Supplement Figure V), which is in line with previous observations in China[37,38] and other countries.[2] In comparison with results of the studies in the 1980s, stroke mortality in China had decreased by 31.0% in urban areas and by 11.4% in rural areas, which is similar to what was observed in the recent GBD Study (Global Burden of Disease).[2]

Surprisingly, unlike findings in other countries,[39] we found no sex differences in the incidence of SAH in China, possibly because of differences in the prevalence

Table 5. Mortality Rates (With 95% CI) of Stroke per 100 000 Chinese Adults (≥20 Years) by Sex in 2012 to 2013

Age Group, y	Men			Women			Total		
	No. of Strokes	Rate	95% CI	No. of Strokes	Rate	95% CI	No. of Strokes	Rate	95% CI
20–29	0	0.0	0.0–0.0	0	0.0	(0.0–0.0)	0	0.0	(0.0–0.0)
30–39	3	6.6	0.0–14.1	1	2.2	(0.0–6.7)	4	4.4	(0.1–8.8)
40–49	20	35.7	20.0–51.3	14	25.4	(12.1–38.8)	34	30.6	(20.3–40.9)
50–59	38	97.0	66.2–127.8	28	70.0	(44.1–95.9)	66	83.3	(63.2–103.4)
60–69	102	351.0	283.0–419.1	51	168.0	(122.0–214.1)	153	257.5	(216.8–298.3)
70–79	147	934.1	783.8–1084.4	104	628.0	(507.7–748.3)	251	777.1	(681.4–872.9)
≥80	107	2237.6	1818.4–2656.8	143	2421.3	(2029.3–2813.3)	250	2339.1	(2052.5–2625.6)
Total	417	176.5	159.6–193.4	341	142.2	(127.1–157.2)	758	159.2	(147.9–170.5)
ASR		122.0	99.0–145.0		107.5	(85.3–129.7)		114.8	(96.3–133.3)

ASR indicates age-standardized rates to China census population 2010; and CI, confidence interval.

and relative significance of risk factors for SAH among countries. For example, the prevalence of smoking (the most important risk factor for SAH)[40,41] among Chinese men (52%) is 18 times greater than in Chinese women (3%), whereas, in the United States, the gap in smoking prevalence between men and women is only ≈6% (24% in men and 18% in women).[42]

Although the proportion of ICH in China (25%) in 2012 to 2013 is significantly greater than in high-income countries (9%–13%)[33] and similar to that observed in other low- to middle-income countries (14%–27%),[33] it is currently lower than that observed in China (28%–55%) 20 to 30 years ago.[43,44] An improved management of hypertension in China may explain this finding. However, the prevalence of hypertension in stroke survivors in China remains very high (84%) in comparison with most other countries,[45] and recent estimates suggest that 73% of the stroke burden in China is attributable to hypertension.[12] These data emphasize the crucial importance of improving blood pressure control in China.

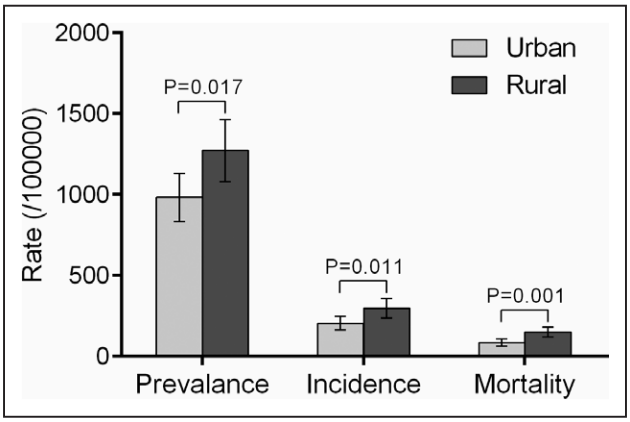

Figure 1. Age-standardized prevalence, incidence, and mortality of stroke in urban and rural areas of China in 2012 to 2013.

Our study confirmed previously observed geographical variations and a North-to-South gradient in stroke in China,[46–49] with the greatest stroke burden observed in the northern and central regions of China. These geographical differences in stroke burden in China may be related to differences in socioeconomic and other risk factors between the regions,[50,51] as also suggested by the greater prevalence of hypertension in northern and central China in comparison with southern regions in our study (online-only Data Supplement Table III), and in prior studies, as well.[47] Large geographical variations in the stroke burden were also observed in other countries.[2]

Our study has several limitations. In this cross-sectional study, recall bias may have resulted in the underestimates of stroke prevalence, incidence and mortality rates, especially for mild strokes. However, cross-checking of the data obtained during the door-to-door interviews with those from medical records should have minimized that possibility. Involving study neurologists to review all identified cases of stroke (including additional CT/MRI brain imaging studies when indicated) further enhanced the accuracy of diagnosis of stroke. However, we did not record and analyze MRI with diffusion-weighted imaging sequences, because this was not a focus of the study. It should also be noted that, although neurologists ascertained the majority of stroke patients, some study participants did not have sufficient details in their medical records. We could have also missed incident fatal and nonfatal stroke cases if the person had lived alone, no one answered the door for the survey, and there was no stroke mentioned in death certificates in the study area. However, we do not believe that this case ascertainment bias played a significant role in our study. We also were not able to collect risk factors for all people who participated in the survey, and the list of risk factors in stroke survivors did not include many important risk factors (eg, diet, physical activity). The lack of measured

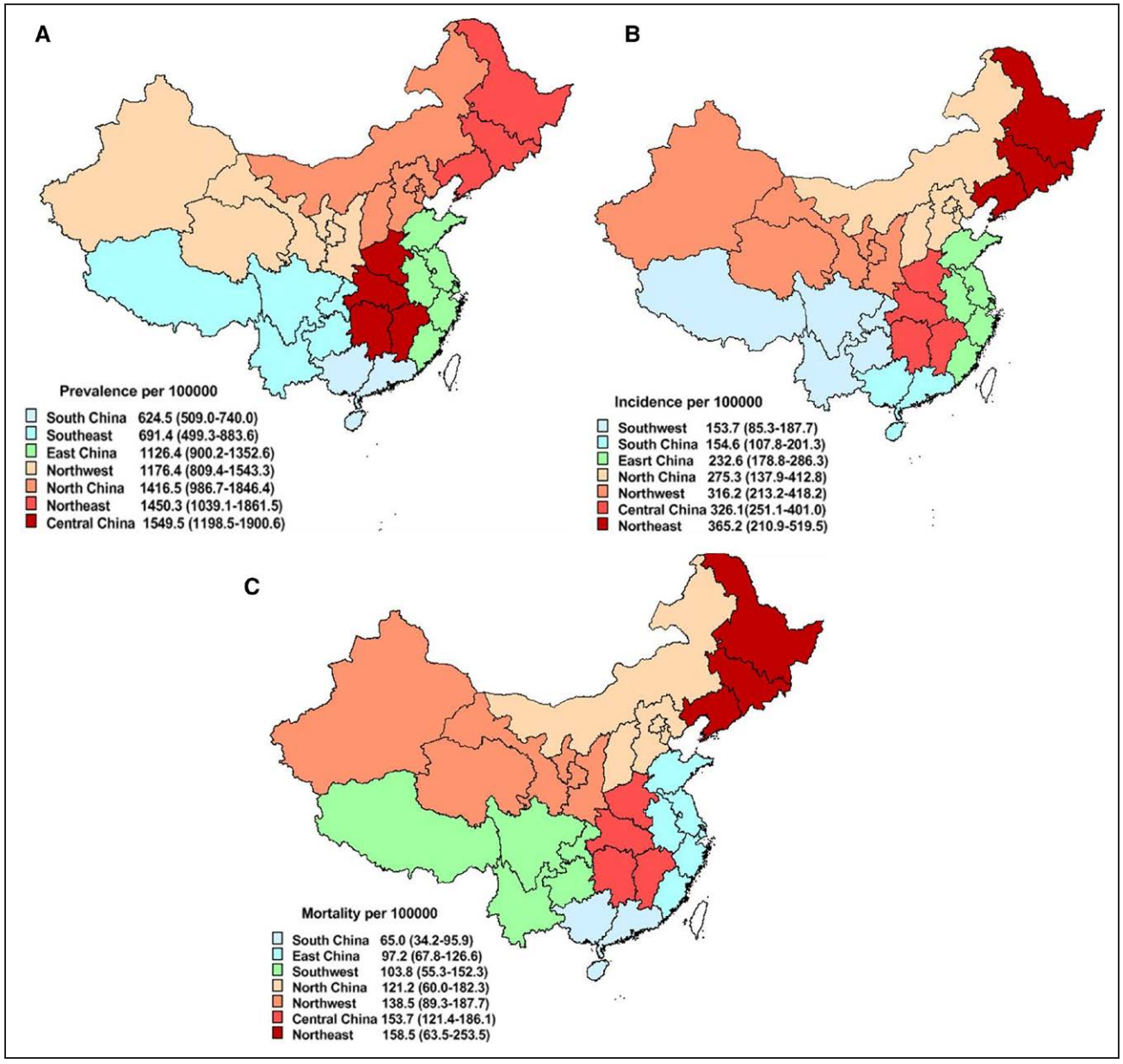

Figure 2. Age-standardized prevalence (A), incidence (B), and mortality (C) rates of stroke in the 7 major geographic regions in China in 2012 to 2013.

blood pressure and potential underrecognition of atrial fibrillation (including paroxysmal atrial fibrillation) are also limitations of our study. The nonresponse rate (19%) was slightly (4%) greater than that we had accounted for in the sample size calculation, and was a limitation of the study. However, we believe this did not largely affect our results because sociodemographic characteristics of nonrespondents were not significantly different from those who were interviewed for the study. The advantages of our study include: (1) national representativeness with very large sample size ensuring sufficient number of men, women, rural and urban study participants from all major regions of China; (2) very high study participation rate (81%), thus minimizing selection bias; (3) all individuals with suspected stroke were reinterviewed by trained neurologists, and CT/MRI brain imaging was arranged when required, thus minimizing diagnostic bias; (4) applying standardized methodology and diagnostic criteria across all study sites in China, thus providing comparable estimates with other high-quality population-based studies; and (5) obtaining not only prevalence, but also incidence and mortality estimates, thus conducting the door-to-door survey in the most cost-efficient manner. To the best of our knowledge, this was the first prevalence study with such a high (90%) verification of pathological types of stroke.

By providing reliable age-specific estimates of prevalence, incidence, and mortality for men and women in

various rural and urban regions/settings across China, our findings have clear implications for practice by allowing priority setting (eg, emphasis on blood pressure control for stroke prevention) and evidence-based region-specific estimates of resources required for acute stroke care and rehabilitation. For example, the greater burden of stroke in northern and central regions of China (especially in rural areas) implies that greater stroke resources are required for these regions. Relatively low (in comparison with developed countries) prevalence of stroke and high stroke mortality rates are indicative of the lack of more effective acute stroke care and rehabilitation in China (eg, insufficient number of acute stroke units, rehabilitation services). It should also be noted that, in the current survey, we obtained data of asymptomatic stroke in the study population, and we found that 19.9% of subjects who had CT/MRI brain imaging had clinically silent lacunar infarction, which may lead to dementia. Because these people did not exhibit clinical signs of acute stroke, they were excluded from the calculation of the prevalence and incidence, but their large number and possible negative consequences on cognitive functioning, combined with the very high and increasing stroke burden identified in China, further underlines the significance of, and urgent need for, primary stroke prevention in China. The northern-south gradient in stroke burden and differences in the prevalence of risk factors across China warrant further research.

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DISCLOSURES

None.

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FOOTNOTES

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Prevalence, Incidence, and Mortality of Stroke in China: Results from a Nationwide Population-Based Survey of 480 687 Adults

Wenzhi Wang, Bin Jiang, Haixin Sun, Xiaojuan Ru, Dongling Sun, Linhong Wang, Limin Wang, Yong Jiang, Yichong Li, Yilong Wang, Zhenghong Chen, Shengping Wu, Yazhuo Zhang, David Wang, Yongjun Wang and Valery L. Feigin
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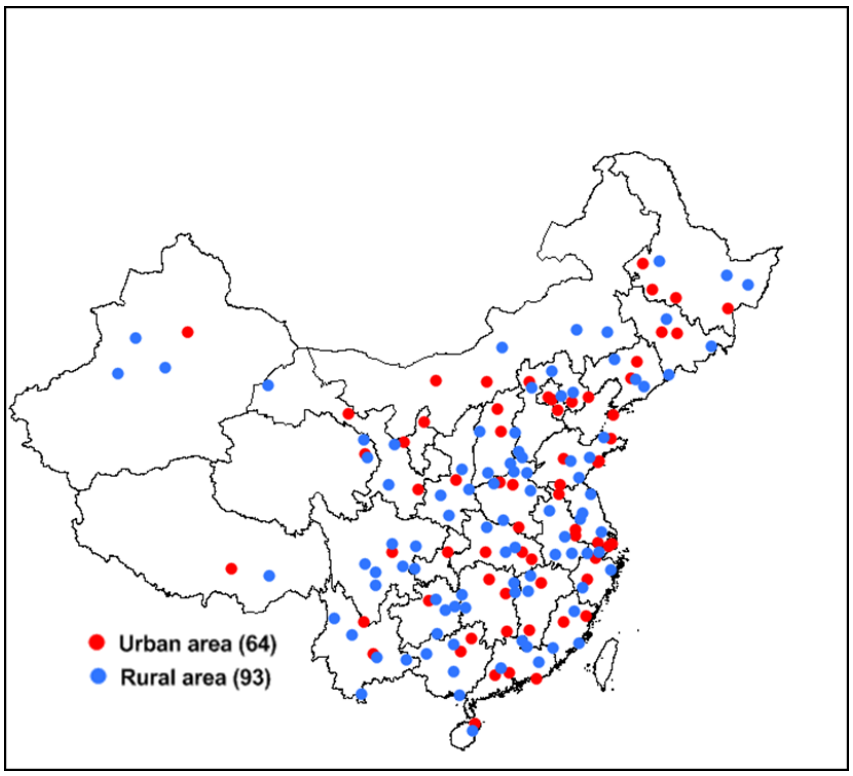
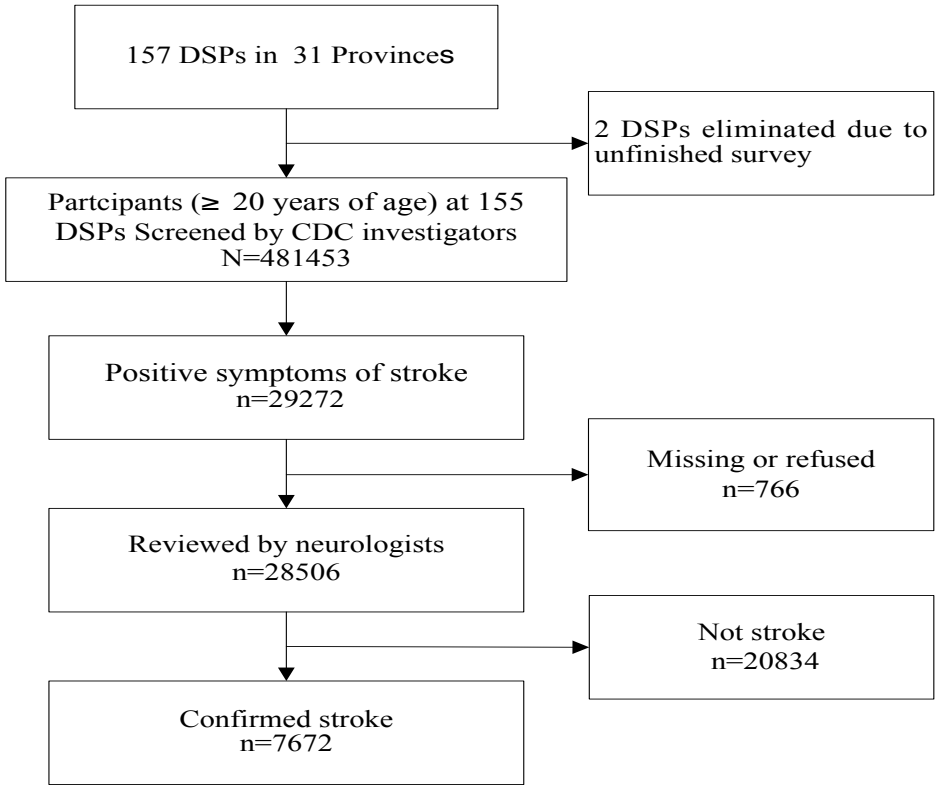
SUPPLEMENTAL MATERIAL

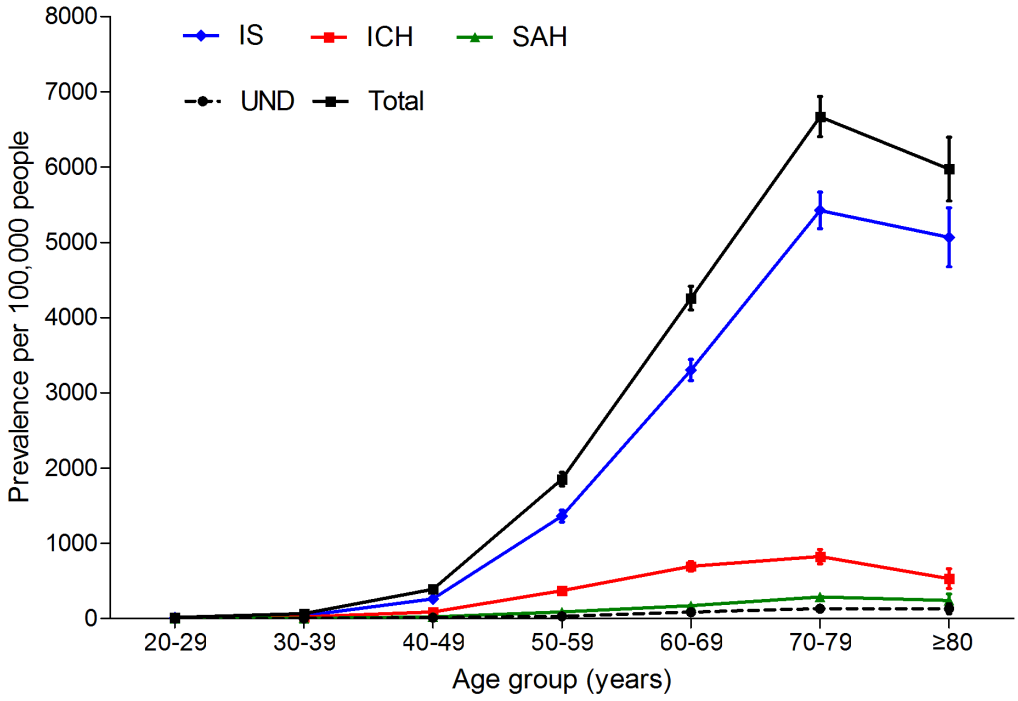
Supplemental Figure 1. 157 Survey Sites in 31 provinces of China



Supplemental Figure 2. Flowchart of stroke cases ascertainment

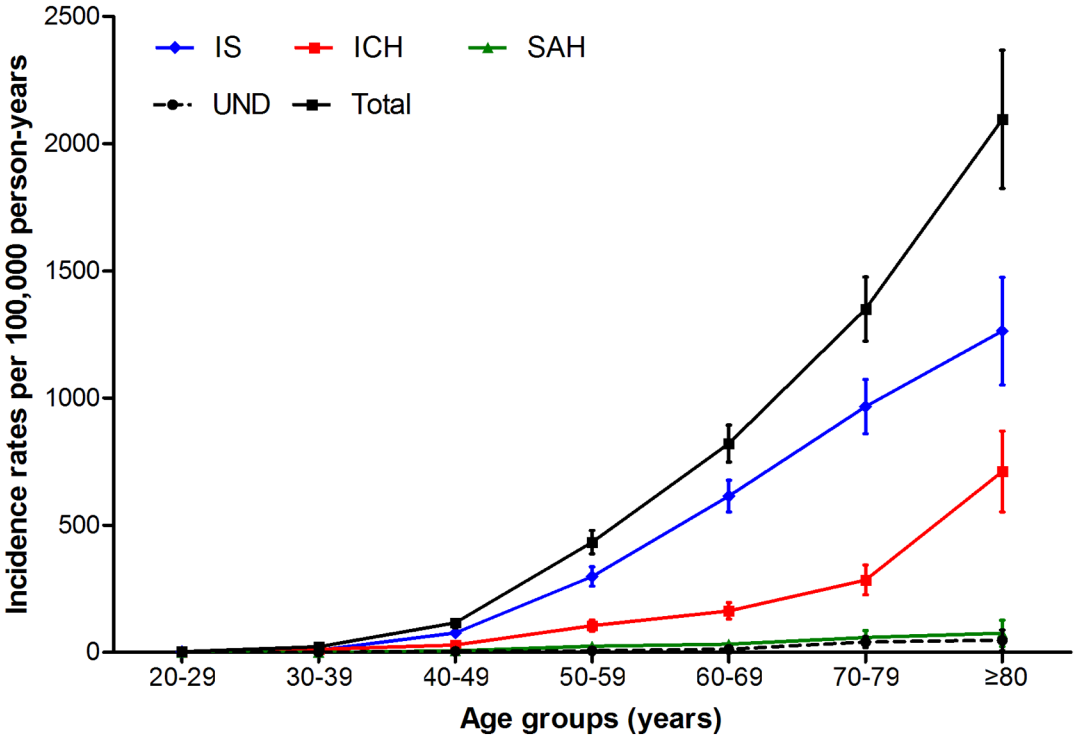


Supplemental Figure 3. Prevalence of stroke (with 95% CI) per 100,000 people in China in 2013 by age and pathological type of stroke



IS=ischaemic stroke; ICH=intracerebral haemorrhage; SAH=subarachnoid haemorrhage; UND= stroke of undetermined pathological type

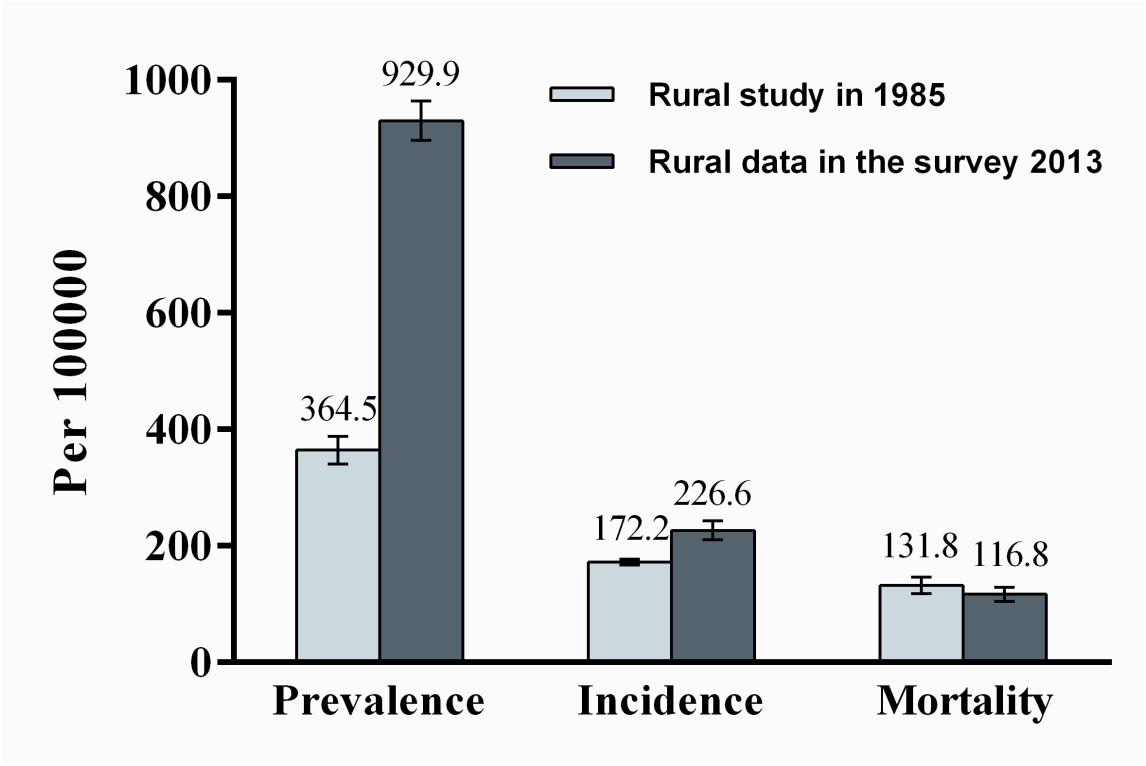
Supplemental Figure 4. Incidence rates (with 95% CI) of stroke per 100,000 person-years in China in 2012-2013 by age and pathological type of stroke

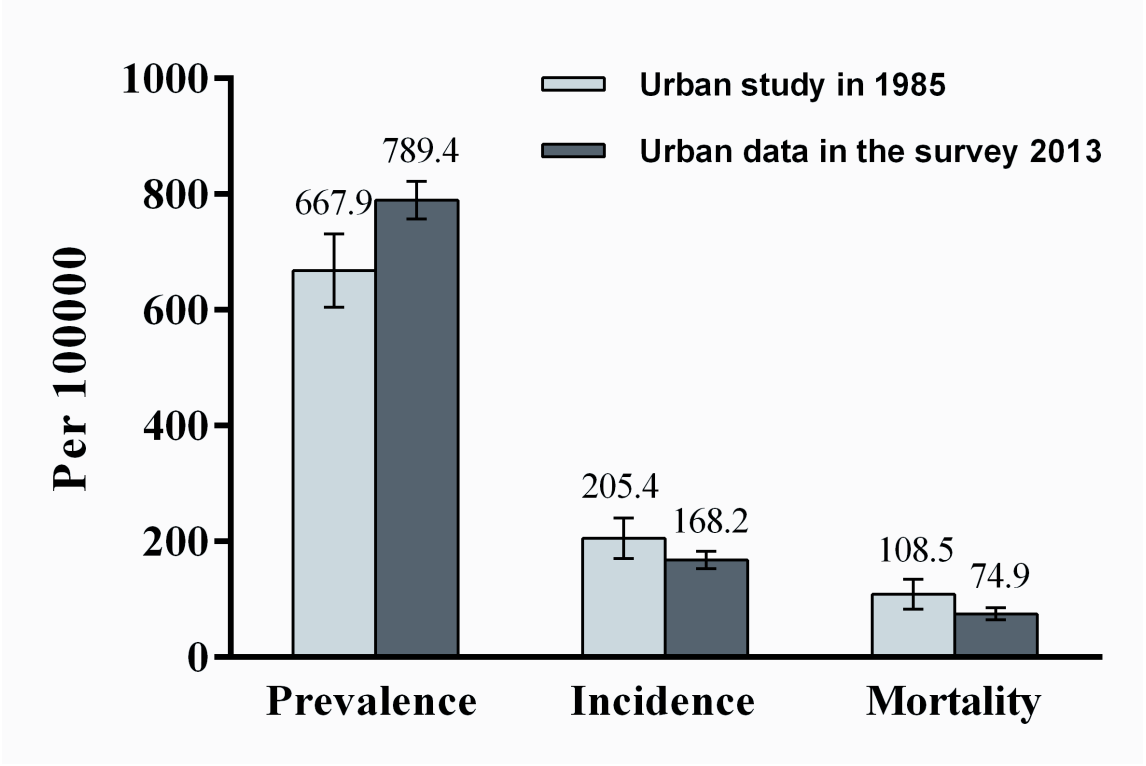


IS=ischaemic stroke; ICH=intracerebral haemorrhage; SAH=subarachnoid haemorrhage; UND= stroke of undetermined pathological type

Supplemental Figure 5. Age-standardized prevalence, incidence and mortality of stroke in urban

and rural areas of China in 2012-2013 compared to survey in 1985





The 1985 survey of 22 provinces in China was organized by Beijing Neurosurgical

Institute. The study design was almost the same as for the current survey, and included random cluster sampling, door-to-door survey, similar questionnaires, same diagnosis criteria and verification methods, including reviews of identified/suspected stroke cases by neurologists. Each survey site consisted of at least 10,000 people, and the total sample size was 246,812 individuals.

Supplemental Table 1. Age-specific and age-standardized stroke prevalence rates per 100,000 person-years (with 95% CIs) in China by sex and stroke pathological types in 2013

Men

Age group (yr)	People at risk	No. of IS*	IS* prevalence	No. of ICH	ICH** prevalence	No. of SAH	SAH*** prevalence	No. of UND¶	UND type prevalence	No. of Total	Total prevalence
20–29	45405	5	11.0 (1.4-20.7)	2	4.4 (0.0-10.5)	0	-	0	-	7	15.4 (4.0-26.8)
30–39	44446	18	40.5 (21.8-59.2)	15	33.7 (16.7-50.8)	2	4.5 (0.0-10.7)	0	-	35	78.7 (52.7-104.8)
40–49	54973	175	318.3 (271.2-365.4)	53	96.4 (70.5-122.4)	13	23.6 (10.8-36.5)	6	10.9 (2.2-19.6)	247	449.3 (393.4-505.2)
50–59	41294	642	1554.7 (1435.4-1674.0)	164	397.2 (336.5-457.8)	41	99.3 (68.9-129.7)	15	36.3 (17.9-54.7)	862	2087.5 (1949.6-2225.4)
60–69	30577	1123	3672.7 (3461.9-3883.5)	242	791.4 (692.1-890.8)	45	147.2 (104.2-190.1)	31	101.4 (65.7-137.1)	1441	4712.7 (4475.2-4950.2)
70–79	16290	995	6108.0 (5740.3-6475.8)	158	969.9 (819.4-1120.4)	48	294.7 (211.4-377.9)	22	135.1 (78.7-191.4)	1223	7507.7 (7103.0-7912.3)
≥80	5442	342	6284.5 (5639.7-6929.2)	33	606.4 (400.1-812.7)	21	385.9 (221.2-550.6)	6	110.3 (22.1-198.4)	402	7387.0 (6692.1-8081.9)
Total	238427	3300	1384.1 (1337.2-1431.0)	667	279.8 (258.5-301.0)	170	71.3 (60.6-82.0)	80	33.6 (26.2-40.9)	4217	1768.7 (1715.8-1821.6)
ASR§			934.7 (821.1-1048.3)		219.0 (181.1-256.9)		48.6 (34.4-62.8)		19.8 (11.4-28.3)		1222.2 (1094.8-1349.5)

Women

Age group (yr)	People at risk	No. of IS*	IS* prevalence	No. of ICH	ICH** prevalence	No. of SAH	SAH*** prevalence	No. of UND¶	UND type prevalence	No. of Total	Total prevalence
20–29	46980	5	10.6 (1.3-20.0)	3	6.4 (0.0-13.6)	0	-	0	-	8	17.0 (5.2-28.8)
30–39	43519	14	32.2 (15.3-49.0)	6	13.8 (2.8-24.8)	2	4.6 (0.0-11.0)	3	6.9 (0.0-14.7)	25	57.4 (34.9-80.0)
40–49	53819	113	210.0 (171.3-248.6)	45	83.6 (59.2-108.0)	12	22.3 (9.7-34.9)	8	14.9 (4.6-25.2)	178	330.7 (282.2-379.2)
50–59	41857	491	1173.0 (1069.9-1276.2)	147	351.2 (294.5-407.9)	32	76.5 (50.0-102.9)	10	23.9 (9.1-38.7)	680	1624.6 (1503.5-1745.7)
60–69	32323	955	2954.6 (2770.0-3139.1)	196	606.4 (521.7-691.0)	64	198.0 (149.5-246.5)	23	71.2 (42.1-100.2)	1238	3830.1 (3620.9-4039.3)
70–79	17186	821	4777.1 (4458.3-5096.0)	118	686.6 (563.1-810.1)	49	285.1 (205.4-364.8)	22	128.0 (74.6-181.5)	1010	5876.9 (5525.2-6228.5)
≥80	6576	267	4060.2 (3583.2-4537.2)	31	471.4 (305.9-637.0)	8	121.7 (37.4-205.9)	10	152.1 (57.9-246.2)	316	4805.4 (4288.4-5322.3)
Total	242260	2666	1100.5 (1058.9-1142.0)	546	225.4 (206.5-244.3)	167	68.9 (58.5-79.4)	76	31.4 (24.3-38.4)	3455	1426.2 (1378.9-1473.4)
ASR§			773.0 (671.9-874.2)		164.4 (137.5-191.2)		48.5 (37.7-59.4)		19.7 (13.2-26.3)		1005.7 (884.2-1127.1)

Both sexes combined

Age group (yr)	People at risk	No. of IS*	IS* prevalence	No. of ICH	ICH** prevalence	No. of SAH	SAH*** prevalence	No. of UND¶	UND type prevalence	No. of Total	Total prevalence
20–29	92385	10	10.8 (4.1-17.5)	5	5.4 (0.7-10.2)	0	-	0	-	15	16.2 (8.0-24.5)
30–39	87965	32	36.4 (23.8-49.0)	21	23.9 (13.7-34.1)	4	4.5 (0.1-9.0)	3	3.4 (0.0-7.3)	60	68.2 (51.0-85.5)
40–49	108792	288	264.7 (234.2-295.3)	98	90.1 (72.3-107.9)	25	23.0 (14.0-32.0)	14	12.9 (6.1-19.6)	425	390.7 (353.6-427.7)
50–59	83151	1133	1362.6 (1283.8-1441.4)	311	374.0 (332.5-415.5)	73	87.8 (67.7-107.9)	25	30.1 (18.3-41.8)	1542	1854.5 (1762.8-1946.2)
60–69	62900	2078	3303.7 (3164.0-3443.3)	438	696.3 (631.4-761.3)	109	173.3 (140.8-205.8)	54	85.9 (63.0-108.7)	2679	4259.1 (4101.3-4417.0)
70–79	33476	1816	5424.8 (5182.1-5667.4)	276	824.5 (727.6-921.3)	97	289.8 (232.2-347.3)	44	131.4 (92.6-170.2)	2233	6670.5 (6403.2-6937.7)
≥80	12018	609	5067.4 (4675.3-5459.5)	64	532.5 (402.4-662.7)	29	241.3 (153.6-329.0)	16	133.1 (67.9-198.3)	718	5974.4 (5550.6-6398.1)
Total	480687	5966	1241.1 (1209.8-1272.4)	1213	252.3 (238.2-266.5)	337	70.1 (62.6-77.6)	156	32.5 (27.4-37.5)	7672	1596.0 (1560.6-1631.5)
ASR§			854.5 (752.5-956.6)		191.9 (162.9-220.9)		48.6 (39.3-57.8)		19.8 (13.1-26.4)		1114.8 (996.5-1233.1)

*IS=ischaemic stroke; **ICH=intracerebral haemorrhage; ***SAH=subarachnoid haemorrhage; UND¶= stroke of undetermined pathological type

§ASR = age-standardized to the China census population 2010

Supplemental Table 2. Age-specific and age-standardized stroke incidence rates per 100,000 person-years (with 95% CIs) in China by sex and stroke pathological types in 2012-2013

Men

Age group (yr)	People at risk	No. of IS*	IS* incidence rates	No. of ICH	ICH** incidence rates	No. of SAH	SAH*** incidence rates	No. of UND¶	UND type incidence rates	No. of Total	Total Incidence rates
20–29	45961	2	4.4 (0.0-10.4)	0	0	0	0	0	0	2	4.4 (0.0-10.4)
30–39	45508	4	8.8 (0.2-17.4)	8	17.6 (5.4-29.8)	0	0	0	0	12	26.4 (11.5-41.3)
40–49	56068	55	98.1 (72.2-124.0)	16	28.5 (14.6-42.5)	4	7.1 (0.1-14.1)	3	5.4 (0.0-11.4)	78	139.1 (108.3-170.0)
50–59	39171	143	365.1 (305.3-424.8)	50	127.6 (92.3-163.0)	12	30.6 (13.3-48.0)	2	5.1 (0.0-12.2)	207	528.5 (456.7-600.3)
60–69	29056	203	698.7 (602.9-794.4)	49	168.6 (121.5-215.8)	9	31.0 (10.7-51.2)	3	10.3 (0.0-22.0)	264	908.6 (799.5-1017.7)
70–79	15737	160	1016.7 (860.0-1173.4)	54	343.1(251.8-434.5)	13	82.6 (37.7-127.5)	7	44.5 (11.5-77.4)	234	1486.9 (1297.8-1676.0)
≥80	4782	68	1422.0 (1086.4-1757.6)	29	606.4 (386.4-826.5)	7	146.4 (38.0-254.7)	2	41.8 (0.0-99.8)	106	2216.6 (1799.4-2633.9)
Total	236283	635	268.7 (247.9-289.6)	206	87.2 (75.3-99.1)	45	19.0 (13.5-24.6)	17	7.2 (3.8-10.6)	903	382.2 (357.3-407.0)
ASR§			181.7 (151.5-211.9)		69.6 (53.6-85.7)		11.7 (6.9-16.5)		3.4 (1.5-5.4)		266.4(226.7-306.1)

Women

Age group (yr)	People at risk	No. of IS*	IS* incidence rates	No. of ICH	ICH** incidence rates	No. of SAH	SAH*** incidence rates	No. of UND¶	UND type incidence rates	No. of Total	Total Incidence rates
20–29	47553	1	2.1 (0.0-6.2)	0	-	0	-	0	0	1	2.1 (0.0-6.2)
30–39	44462	4	9.0 (0.2-17.8)	3	6.7 (0.0-14.4)	1	2.2 (0.0-6.7)	0	0	8	18.0 (5.5-30.5)
40–49	55022	30	54.5 (35.0-74.0)	16	29.1 (14.8-43.3)	3	5. (0.0-11.6)	2	3.6 (0.0-8.7)	51	92.7 (67.3-118.1)
50–59	40017	93	232.4 (185.2-279.6)	33	82.5 (54.3-110.6)	7	17.5 (4.5-30.4)	3	7.5 (0.0-16.0)	136	339.9 (282.8-396.9)
60–69	30352	162	533.7 (451.8-615.7)	48	158.1 (113.4-202.8)	10	32.9 (12.5-53.4)	4	13.2 (0.3-26.1)	224	738.0 (641.7-834.3)
70–79	16561	152	917.8 (772.6-1063.1)	38	229.5 (156.6-302.3)	6	36.2 (7.2-65.2)	6	36.2 (7.2-65.2)	202	1219.7 (1052.6-1386.9)
≥80	5906	67	1134.4 (864.3-1404.5)	47	795.8 (569.2-1022.4)	1	16.9 (0.0-50.1)	3	50.8 (0.0-108.3)	118	1998.0 (1641.1-2354.8)
Total	239873	509	212.2 (193.8-230.6)	185	77.1 (66.0-88.2)	28	11.7 (7.3-16.0)	18	7.5 (4.0-11.0)	740	308.5 (286.3-330.7)
AAR§			151.9 (122.1-181.8)		62.7 (47.5-78.0)		7.9 (3.8-12.0)		4.3 (1.4-7.3)		226.9 (187.5-266.3)

Both sexes combined

Age group (yr)	People at risk	No. of IS*	IS* incidence rates	No. of ICH	ICH** incidence rates	No. of SAH	SAH*** incidence rates	No. of UND[¶]	UND type incidence rates	No. of Total	Total Incidence rates
20–29	93514	3	3.2 (0.0-6.8)	0	-	0	-	0	-	3	3.2(0.0-6.8)
30–39	89970	8	8.9 (2.7-15.1)	11	12.2 (5.0-19.5)	1	1.1 (0.0-3.3)	0	-	20	22.2 (12.5-32.0)
40–49	111090	85	76.5 (60.3-92.8)	32	28.8 (18.8-38.8)	7	6.3 (1.6-11.0)	5	4.5 (0.6-8.4)	129	116.1 (96.1-136.1)
50–59	79188	236	298.0 (260.1-336.0)	83	104.8 (82.3-127.4)	19	24.0 (13.2-34.8)	5	6.3 (0.8-11.8)	343	433.1 (387.4-478.9)
60–69	59408	365	614.4 (551.6-677.2)	97	163.3 (130.8-195.7)	19	32.0 (17.6-46.4)	7	11.8 (3.1-20.5)	488	821.4 (748.9-894.0)
70–79	32298	312	966.0 (859.3-1072.7)	92	284.8(226.7-343.0)	19	58.8 (32.4-85.3)	13	40.3 (18.4-62.1)	436	1349.9 (1224.1-1475.8
≥80	10688	135	1263.1(1051.4-1474.8)	76	711.1(551.8-870.4)	8	74.9 (23.0-126.7)	5	46.8 (5.8-87.8)	224	2095.8 (1824.2-2367.4
Total	476156	1144	240.3 (226.4-254.2)	391	82.1(74.0-90.3)	73	15.3 (11.8-18.8)	35	7.4 (4.9-9.8)	1643	345.1 (328.4-361.7)
ASR[§]			166.9 (140.1-193.7)		66.2 (52.7-79.7)		9.8 (6.5-13.2)		3.9 (2.0-5.7)		246.8 (211.2-282.5)

*IS= ischaemic stroke; **ICH=intracerebral haemorrhage; ***SAH=subarachnoid haemorrhage; UND[¶]= stroke of undetermined pathological type

[§]ASR = age-standardized to the China census population 2010

Supplemental Table 3. Prevalence of some risk factors in 7,672 people with prevalent stroke in seven major districts of China in 2013

		East China N (%)	South China N (%)	Central China N (%)	North China N (%)	Northwest N (%)	Southwest N (%)	Northeast N (%)	P
Hypertension	Yes	1378(88.11)	318(81.54)	1389(87.58)	1052(74.03)	753(88.69)	442(81.70)	1131(85.62)	<0.001
	No	168(10.74)	55(14.10)	165(10.40)	126(8.87)	80(9.42)	68(12.57)	163(12.34)	
	Missed	18(1.15)	17(4.36)	32(2.02)	243(17.10)	16(1.88)	31(5.73)	27(2.04)	
Diabetes	Yes	222(14.19)	70(17.95)	227(14.31)	228(16.05)	99(11.66)	53(9.80)	189(14.31)	<0.001
	No	1250(79.92)	279(71.54)	1272(80.20)	848(59.68)	664(78.21)	434(80.22)	1041(78.80)	
	Missed	92(5.88)	41(10.51)	87(5.49)	345(24.28)	86(10.13)	54(9.98)	91(6.89)	
Dyslipidaemia	Yes	280(17.90)	105(26.92)	436(27.49)	331(23.29)	180(21.20)	65(12.01)	274(20.74)	<0.001
	No	855(54.67)	146(37.44)	808(50.95)	820(57.71)	359(42.29)	341(63.03)	644(48.75)	
	Missed	429(27.43)	139(35.64)	342(21.56)	270(19.00)	310(36.51)	135(24.95)	403(30.51)	
Atrial fibrillation	Yes	41(2.62)	17(4.36)	28(1.77)	54(3.80)	20(2.36)	8(1.48)	37(2.80)	<0.001
	No	1342(85.81)	301(77.18)	1412(89.03)	1262(88.81)	604(71.14)	447(82.62)	1086(82.21)	
	Missed	181(11.57)	72(18.46)	146(9.21)	105(7.39)	225(26.50)	86(15.90)	198(14.99)	
CHD	Yes	200(12.79)	47(12.05)	321(20.24)	226(15.90)	133(15.67)	19(3.51)	342(25.89)	<0.001
	No	1173(75.00)	268(68.72)	1058(66.71)	1042(73.33)	556(65.49)	434(80.22)	810(61.32)	
	Missed	191(12.21)	75(19.23)	207(13.05)	153(10.77)	160(18.85)	88(16.27)	169(12.79)	
Current smoker	Yes	671(42.90)	175(44.87)	691(43.57)	750(52.78)	369(43.46)	250(46.21)	748(56.62)	<0.001
	No	863(55.18)	200(51.28)	792(49.94)	599(42.15)	458(53.95)	254(46.95)	543(41.11)	
	Missed	30(1.92)	15(3.85)	103(6.49)	72(5.07)	22(2.59)	37(6.84)	30(2.27)	
Alcohol drinking	Yes	678(43.35)	187(47.95)	618(38.97)	644(45.32)	298(35.10)	256(47.32)	690(52.23)	<0.001
	No	856(54.73)	187(47.95)	867(54.67)	704(49.54)	529(62.31)	248(45.84)	602(45.57)	
	Missed	30(1.92)	16(4.10)	101(6.37)	73(5.14)	22(2.59)	37(6.84)	29(2.20)	

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