Self-Rated Health Status and Risk of Incident Stroke in 0.5 Million Chinese Adults: The China Kadoorie Biobank Study

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Background and purpose Self-rated health (SRH) is a consistent and strong predictor of all-cause and cardiovascular mortality in various populations. However, the associations between SRH measures and risk of first-ever or recurrent stroke were rarely explored. We thus aim to prospectively investigate the associations between SRH measures and risk of total and subtypes of stroke in Chinese population.

Methods A total of 494,113 participants from the China Kadoorie Biobank without prior heart diseases or cancer (486,541 without stroke and 7,572 with stroke) were followed from baseline (2004 to 2008) until December 31, 2013. General and age-comparative SRH were obtained from baseline questionnaires. First-ever stroke or recurrent events were ascertained through linkage to disease registry system and health insurance data.

Results We identified 27,662 first-ever stroke and 2,909 recurrent events during an average of 7.0 years of follow-up. Compared with excellent general SRH, the hazard ratios (HRs) and 95% confidence intervals (CIs) for first-ever stroke associated with good, fair, and poor general SRH were 1.04 (1.00 to 1.08), 1.19 (1.15 to 1.23), and 1.49 (1.42 to 1.56) in the multivariate model, respectively. Compared with better age-comparative SRH, the HRs (95% CIs) of same and worse age-comparative SRH were 1.13 (1.10 to 1.17) and 1.51 (1.45 to 1.58), respectively. The relations of SRH measures with ischemic stroke, hemorrhagic stroke, and recurrent stroke were similar to that with total first-ever stroke. However, the magnitude of associations was much stronger for fatal stroke than for non-fatal stroke.

Conclusions This large-scale prospective cohort suggests that self-perceived health status is associated with incident stroke, regardless of stroke subtype.

Keywords Health status; Stroke; Prospective studies

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Introduction

Despite great improvements in medical care and decreasing age-standardized mortality, stroke has constantly been a leading cause of mortality and disability-adjusted life-years in China.[1,2] According to a nation-wide survey in 2013, approximately 2.4 million newly-onset stroke and 1.1 million stroke deaths occurred annually, making China a country with greatest burden of stroke worldwide.[3] Additionally, the rising prevalence of risk factors for stroke such as obesity, diabetes, and population aging were projected to further increase the incidence of stroke, as was already found in rural China.[4,5] Thus, it is of great importance to scale-up the primary prevention actions; in addition, the identification of more potential risk factors and predictors, especially easily obtained factors, may be beneficial in the perspective of public health.

Self-rated health (SRH) status, often used in the form of general SRH and/or age-comparative SRH, is a relatively subjective and multifaceted measure of personal health. It has been found to be an independent predictor of all-cause mortality,[6-9] cardiovascular morbidity and mortality[8-13] in various populations. However, the predictive value of SRH on incident stroke was less investigated. To our best knowledge, only four studies had evaluated the association with inconsistent findings.[13-16] Additionally, none of the studies explored whether the associations were different across stroke subtypes, or whether age-comparative SRH was associated with incident stroke. In addition, no study has evaluated the association between SRH and stroke morbidity in Chinese population.

We therefore used data from an ongoing prospective cohort study, the China Kadoorie Biobank (CKB) study, to prospectively investigate the relationships of both general SRH and age-comparative SRH with risk of stroke.

Methods

Study population

Detailed information of the CKB study design, sampling strategy, survey methods, and long-term follow-up have been reported elsewhere.[17] Briefly, a total of 512,891 participants aged 30 to 79 years old from 10 regions of China were enrolled between 2004 and 2008. Baseline information including demographic characteristics, personal medical history, mental health, and lifestyles was obtained by trained staff from local Centers for Disease Control and Prevention (CDC) and survey teams through face-to-face interviews. Height, weight, and blood pressures were measured for each participant.

For this study, we excluded participants with a prior history of cancer (n=2,577), coronary heart disease (n=15,472), rheumatic heart disease (n=938), or stroke (n=8,884), as well as two individuals with missing values of body mass index (BMI). Finally, a total of 486,541 participants (199,113 men and 287,428 women) were included in the analysis of SRH measures and first-ever stroke, while 7,572 participants with prior history of stroke remained for the analysis of SRH measures and recurrent stroke after excluding those with cancer (n=64), coronary heart disease (n=1,227), and rheumatic heart disease (n=46) at baseline (25 of them had more than one disease).

The study was approved by the Ethical Review Committee of the Chinese CDC (Beijing, China) and the Oxford Tropical Research Ethics Committee, University of Oxford (Oxford, United Kingdom). Written informed consent forms were obtained from all participants.

Assessment of general and age-comparative SRH

SRH status was inquired by two questions at baseline: (1) how is your current general health status: excellent, good, fair, or poor? and (2) how is your current health status compared with someone of your own age: better, about the same, worse, or don't know? The first question was considered as general SRH and the second as age-comparative SRH. Participants answering "don't know" for the second question (n=14,990, 3.1%) were further excluded for analysis of the association between age-comparative SRH and stroke risk.

Ascertainment of stroke mortality and morbidity

Stroke mortality and morbidity of each participant was obtained by regular linkage to regional disease and death registers and with the national health insurance database.[17] For those who were not included in the system, dedicated staff members annually ascertained their status including disease development, hospital admission, death, and migration. Presently, 98% of the study population was covered by the health insurance system. Follow-up information was complete for 99.4% of the participants.

Stroke was defined as a focal neurological deficit of sudden or rapid onset lasting ≥24 hours or until death, confirmed by computed tomography or magnetic resonance imaging. A fatal stroke event was one resulting in death within 28 days; a non-fatal event denoted survival at least 28 days after stroke onset.[18] All new cases were coded as I60 (subarachnoid stroke), I61 (hemorrhagic stroke), I63 (ischemic stroke), I64 (other or unknown stroke type) according to the International Classification of Diseases, 10th reversion by trained staff.

Covariates

Demographic and socioeconomic characteristics such as age, sex, study area (10 regions), marital status (married, widowed, separated/divorced, and never married), education (no formal education, 1 to 6, 7 to 13, and ≥14 years of education), annual household income (<10,000, 10,000 to 19,999, 20,000 to 34,999, and ≥35,000 Yuan), occupation (farmers, factory workers, professionals and managers, retirees, unemployed and others), house/apartment owning (yes, no), and healthcare coverage (yes, no) were obtained in baseline interview. Lifestyle factors were also inquired, including smoking status (never, former, occasionally, and current smoker), alcohol drinking (never, former, occasionally, and weekly drinker), physical activity (calculated as metabolic equivalent tasks hours for daily work or leisure activities) and sleep problems (yes, no). Women were additionally asked about their menopausal status (pre-, peri-, and post-menopause). Family history of stroke (yes, no) and personal medical history (hypertension, diabetes, and 11 other medical conditions including tuberculosis, asthma, cirrhosis, chronic hepatitis, peptic ulcer, gall/bladder stone, kidney disease, fracture, rheumatoid arthritis, psychiatric disorder, and head injury) were also obtained. Participants with a fasting plasma glucose ≥7.0 mmol/L, or random blood glucose ≥11.1 mmol/L, or self-reported diagnosis of diabetes mellitus were defined as having prevalent diabetes.[19] Participants reporting diagnosis of hypertension, or measured systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg were considered as having prevalent hypertension.[20] The Chinese version of computerized Composite International Diagnostic Inventory-short form (CIDI-SF) was used to assess past year major depressive episodes.[21] BMI was calculated as measured weight in kilograms divided by the square of height in meters.

Statistical analyses

Baseline characteristics according to SRH categories were compared using analysis of variance and chi-square tests for continuous and categorical variables, respectively. Person-years were calculated by entry into the study until the onset of stroke, death, loss to follow-up, or December 31, 2013, whichever came first. Multivariate Cox proportional hazards regression were used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for associations between SRH measures and incident stroke after proportional assumption was tested and no violation was identified. Two models were used in analysis: (1) model 1 adjusted for age (continuous), marital status, education, annual household income, occupation, healthcare coverage, housing condition, menopausal status, sleep problems, cigarette smoking, alcohol drinking, physical activity

(continuous), BMI (continuous), and family history of stroke; (2) model 2 adjusted for model 1 plus baseline presence of major depressive episodes, diabetes, hypertension, and other prevalent diseases (yes, no). The definitions of all categorical variables were illustrated in the "Covariates" section.

Stratified analysis were performed according to age groups (30 to 64 and ≥65 years old), sex, administrative regions, education, annual household income, cigarette smoking, alcohol drinking, physical activity groups (three groups—low, moderate, and high—were generated according to the tertiles of physical activity), BMI groups (<18.5, 18.5 to 23.9, 24.0 to 27.9, and ≥28.0 kg/m^2), hypertension, and diabetes. Tests for interaction were conducted by adding interaction terms in the multivariate model. Finally, sensitivity analyses were performed by excluding major depressive episodes, baseline comorbidities (diabetes, hypertension, and other comorbidities), or those who died or developed stroke in the first 2 years of follow-up. All Cox models were conducted with stratification according to age at baseline (in 5-year intervals), sex, and study areas when appropriate.

For all analyses, general and age-comparative SRH were analyzed separately as exposures; we also incorporated the two measures in one model to explore whether they were independent of each other. In addition, first-ever hemorrhagic, ischemic, fatal, non-fatal stroke, and recurrent stroke were also analyzed as outcomes separately. All data analyses were conducted using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA), two-sided P-values <0.05 were considered as statistical significance.

Results

Baseline characteristics stratified by general SRH categories are shown in Table 1. Among the 486,541 participants, 88,340 (18.2%) reported excellent general SRH, 141,022 good (29.0%), 212,158 fair (43.6%), and 45,021 (9.2%) reported poor SRH. Individuals reporting poor general SRH were more likely to be older, female, unmarried, poor, physical inactive, postmenopausal (women), from rural China and had a higher prevalence of sleep problems, diabetes, hypertension, major depressive episodes, or other medical conditions; and they were less likely to have higher education level and healthcare coverage, or own houses, to be employed, current smokers or weekly drinkers (all P<0.001).

Baseline characteristics according to age-comparative SRH are presented in Supplemental Table 1. In 486,541 participants, 90,738 (18.7%) reported better, 309,022 (63.5%) reported same, and 71,791 (14.8%) reported worse age-comparative

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Table 1. Baseline characteristics according to general self-rated health status

Characteristic	Total (n=486,541)	General self-rated health			
		Excellent (n=88,340)	Good (n=141,022)	Fair (n=212,158)	Poor (n=45,021)
Sociodemographic factor					
Age, mean±SD (yr)	51.0±10.5	49.4±10.4	50.4±10.3	51.8±10.6	52.7±10.7
Female sex (%)	59.1	53.5	57.5	61.0	65.9
Married (%)	90.9	92.2	92.2	90.1	87.9
No formal education (%)	18.7	15.1	20.4	17.1	24.8
Annual household income ≥35,000 Yuan (%)	18.1	24.2	20.4	15.8	10.0
Unemployed or not stated (%)	14.3	11.9	12.2	15.7	19.7
Healthcare coverage (%)	82.1	86.2	83.9	80.3	76.4
House/apartment owning (%)	44.6	46.2	48.6	42.8	37.0
Rural area (%)	56.9	44.0	63.2	56.5	64.2
Lifestyle factor					
Current regular smoker (%)	26.8	30.5	28.3	24.9	23.5
Weekly alcohol drinker (%)	15.1	19.8	16.8	13.2	10.0
Physical activity, mean±SD (MET-hr/day)	21.6±13.9	22.7±13.8	23.4±14.4	20.4±13.5	19.1±13.5
Sleep problems (%)	16.4	9.4	13.0	18.0	33.1
Personal/family medical history					
BMI, mean±SD (kg/m²)	23.6±3.4	23.8±3.2	23.7±3.3	23.5±3.4	23.3±3.7
Postmenopausal (women only) (%)	50.7	41.6	47.2	54.0	60.8
Family history of stroke (%)	17.5	17.4	17.2	17.3	19.9
Prevalent diabetes (%)	5.4	3.6	3.8	6.1	10.5
Prevalent hypertension (%)	32.6	28.3	31.7	34.0	37.3
Prevalent major depressive episodes (%)	0.6	0.2	0.3	0.6	2.1
Other prevalent medical conditions (%)	21.9	17.5	18.2	23.0	36.9

Two-sided P-values were derived from ANOVA for continuous variables and from the chi-square test for categorical variables, all P-values comparing the difference between general self-rated health status groups <0.001.
SD, standard deviation; MET, metabolic equivalent; BMI, body mass index.

SRH. Comparisons of characteristics between better and worse age-comparative SRH were consistent with those between excellent and poor general SRH.

During 7.0±1.5 years of follow-up, a total of 27,662 first-ever stroke cases (5.69%) were identified (5,287 hemorrhagic stroke [intracerebral or subarachnoid], 21,449 ischemic stroke, and 926 other or unspecified stroke), among which 3,519 events were fatal and 24,143 cases were non-fatal. The HR comparing excellent with poor general SRH after adjustment for sociodemographic factors, lifestyles, and family history of stroke (Table 2) was 1.65 (95% CI, 1.58 to 1.73), and it was slightly weakened to 1.49 (95% CI, 1.42 to 1.56) after further controlling for various comorbidities. Similar magnitudes of association were found with hemorrhagic and ischemic stroke, while the association was stronger for fatal stroke (HR, 1.92; 95% CI, 1.69 to 2.19) than non-fatal stroke (HR, 1.43; 95% CI, 1.36 to 1.51) (Table 2). The survival curves by general SRH was

depicted in Figure 1 and Supplementary Figure 1.

Significant interactions were found between general SRH with age, administrative region, education, and BMI status in terms of the risk of total stroke (all $P_{interaction}$ <0.05); the association was stronger in younger participants, those from rural regions, those with higher education levels, and those with lower BMI (Figure 2 and Supplementary Table 2).

Relative to those who reported better age-comparative SRH status, participants reporting worse age-comparative SRH had a 51% increased risk of developing stroke (HR, 1.51; 95% CI, 1.45 to 1.58) (Table 2). Similarly, the association was slightly stronger for fatal stroke (HR, 1.81; 95% CI, 1.62 to 2.03) than with non-fatal stroke (HR, 1.47; 95% CI, 1.40 to 1.53) (Table 2). The survival curves according to age-comparative SRH were shown in Figure 1 and Supplementary Figure 1. In stratified analyses, effect modification by education, income, cigarette smoking, and alcohol drinking was observed; the association was stronger for

Table 2. Association of SRH measures with risk of categories of first-ever stroke and recurrent stroke*

Outcomes	Exposures	Cases/person-years	Number	Model 1[†] HR (95% CI)	Model 2[‡] HR (95% CI)
First-ever stroke	General SRH				
	Excellent	4,204/624,889	88,340	1.00	1.00
	Good	6,487/1,011,388	141,022	1.06 (1.02–1.10)	1.04 (1.00–1.08)
	Fair	13,332/1,476,873	212,158	1.25 (1.21–1.30)	1.19 (1.15–1.23)
	Poor	3,639/311,654	45,021	1.65 (1.58–1.73)	1.49 (1.42–1.56)
	Age-comparative SRH				
	Better	4,881/649,274	90,738	1.00	1.00
	Same	16,635/2,173,173	309,022	1.18 (1.14–1.22)	1.13 (1.10–1.17)
	Worse	5,121/502,526	71,791	1.66 (1.60–1.73)	1.51 (1.45–1.58)
Hemorrhagic stroke	General SRH				
	Excellent	647/608,810	84,783	1.00	1.00
	Good	1,329/988,044	135,864	1.12 (1.02–1.23)	1.09 (0.99–1.20)
	Fair	2,471/1,429,038	201,297	1.24 (1.13–1.35)	1.18 (1.08–1.29)
	Poor	840/299,326	42,222	1.79 (1.60–1.99)	1.62 (1.46–1.81)
	Age-comparative SRH				
	Better	762/630,069	86,619	1.00	1.00
	Same	3,238/2,114,115	295,625	1.17 (1.08–1.27)	1.14 (1.05–1.23)
	Worse	1,138/484,995	67,808	1.70 (1.54–1.87)	1.57 (1.42–1.73)
Ischemic stroke	General SRH				
	Excellent	3,424/621,693	87,560	1.00	1.00
	Good	4,948/1,005,099	139,483	1.05 (1.01–1.10)	1.03 (0.99–1.08)
	Fair	10,436/1,465,266	209,262	1.26 (1.21–1.31)	1.20 (1.15–1.25)
	Poor	2,641/307,795	44,023	1.61 (1.53–1.70)	1.45 (1.38–1.53)
	Age-comparative SRH				
	Better	3,968/645,403	89,825	1.00	1.00
	Same	12,883/2,158,145	305,270	1.18 (1.14–1.23)	1.14 (1.10–1.18)
	Worse	3,759/497,264	70,429	1.65 (1.57–1.73)	1.49 (1.42–1.57)
Fatal stroke	General SRH				
	Excellent	406/607,949	84,542	1.00	1.00
	Good	791/986,088	135,326	1.09 (0.96–1.23)	1.06 (0.94–1.20)
	Fair	1,615/1,426,221	200,441	1.34 (1.19–1.49)	1.27 (1.13–1.42)
	Poor	707/298,960	42,089	2.14 (1.88–2.44)	1.92 (1.69–2.19)
	Age-comparative SRH				
	Better	518/629,292	86,375	1.00	1.00
	Same	1,971/2,109,701	294,358	1.21 (1.09–1.34)	1.17 (1.06–1.29)
	Worse	923/484,323	67,593	1.99 (1.78–2.22)	1.81 (1.62–2.03)
Non-fatal stroke	General SRH				
	Excellent	3,798/623,080	87,934	1.00	1.00
	Good	5,696/1,007,867	140,231	1.06 (1.01–1.10)	1.04 (1.00–1.08)
	Fair	11,717/1,469,778	210,543	1.25 (1.20–1.30)	1.18 (1.14–1.23)
	Poor	2,932/308,775	44,314	1.58 (1.51–1.67)	1.43 (1.36–1.51)
	Age-comparative SRH				
	Better	4,363/646,869	90,220	1.00	1.00
	Same	14,664/2,164,519	307,051	1.17 (1.13–1.22)	1.13 (1.09–1.17)
	Worse	4,198/498,788	70,868	1.62 (1.55–1.69)	1.47 (1.40–1.53)

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Table 2. Continued

Outcomes	Exposures	Cases/person-years	Number	Model 1[†] HR (95% CI)	Model 2[‡] HR (95% CI)
Recurrent stroke	General SRH				
	Excellent	210/3,285	585	1.00	1.00
	Good	319/4,960	881	1.27 (1.06–1.52)	1.26 (1.06–1.51)
	Fair	1,272/18,806	3,416	1.27 (1.09–1.48)	1.26 (1.08–1.46)
	Poor	1,108/13,805	2,690	1.50 (1.28–1.75)	1.46 (1.25–1.70)
	Age-comparative SRH				
	Better	226/3,585	622	1.00	1.00
	Same	1,128/17,585	3,173	1.16 (1.00–1.34)	1.14 (1.00–1.32)
	Worse	1,483/18,510	3,554	1.48 (1.28–1.71)	1.43 (1.23–1.65)

SRH, self-rated health; HR, hazard ratio; CI, confidence interval.
*A total of 486,541 participants were included in the analysis of SRH measures and first-ever stroke, and 7,572 participants with prior history of stroke were included for the analysis of SRH measures and recurrent stroke; [†]Model 1: Stratified by age (5 years intervals), sex, region (10 areas) and adjusted for age (continuous), marital status, education, annual household income, occupation, healthcare coverage, housing condition, menopausal status, sleep problems, cigarette smoking, alcohol drinking, physical activity (continuous), body mass index (continuous), and family history of stroke; [‡]Model 2: Model 1 plus presence of major depressive episodes, diabetes, hypertension, and other prevalent diseases (yes, no). The categories and definitions of all categorical variables were illustrated in the 'Covariates' section of the Methods.

participants with higher education and income, and who were former smoker and drinker (Supplemental Table 3).

In sensitivity analyses, associations of both general and age-comparative SRH with risk of first-ever stroke and stroke subtype merely changed (Supplemental Table 4). When general SRH and age-comparative SRH were incorporated into one model, their effect sizes were attenuated but both remained significant (Supplemental Table 5).

Among 7,572 participants with prior stroke, 2,909 developed another stroke during follow-up. The HR comparing poor with excellent general SRH was 1.46 (95% CI, 1.25 to 1.70) and 1.43 (95% CI, 1.23 to 1.65) comparing worse with better age-comparative general SRH (Table 2). The survival curves free of recurrent stroke by SRH measures were presented in Figure 1.

Discussion

In this large-scale population-based prospective cohort study, we found that both general and age-comparative SRH were significantly associated with an increased risk of first-ever stroke and recurrent stroke in Chinese adults. The magnitude of associations was similar in predicting hemorrhagic and ischemic stroke, yet stronger in predicting fatal than non-fatal stroke. All associations were independent of various well-established stroke risk factors.

Though recommended as a key measure of cardiovascular health in disease surveillance,[22] the association between SRH and incident stroke was not extensively investigated. In several studies in US and European populations,[13-15] poor SRH was asso-

ciated with a higher risk of first-ever stroke. However, they had relatively small sample size (ranged from 168 to 473 incident cases), and some studies combined the SRH measure into two categories (excellent/good vs. fair/poor). With regard to the association between SRH and recurrent stroke, two studies in UK populations did not find significant association,[14,16] but the sample size was small: Mavaddat et al.[14] identified 77 recurrent cases out of 434 stroke patients during 2 years' follow-up and Hillen et al.[16] identified 66 recurrent cases out of 561 stroke patients during 5 years' follow-up. Therefore, our study is thus the largest prospective cohort study on this topic and the first of its kind in Asians. Participants in the CKB study were from 10 geographically distant regions, and had different socioeconomic background, dietary patterns, lifestyles, and disease profiles. Therefore, we believe that our study provides compelling evidence on the association between SRH and incident stroke.

Our study is the first prospective study on the association between SRH and different subtypes of stroke, and we found similar magnitudes of the associations for hemorrhagic and ischemic stroke. Although the pathophysiology of the two stroke subtype is different, they share similar risk factors that can be perceived by individuals, such as obesity, hypertension, smoking, and old age.[23] We also investigated the relations of SRH with fatal and nonfatal stroke. Our results of non-fatal stroke were similar with two previous studies.[13,14] No study has specifically examined the association between general SRH and fatal stroke, while some studies reported inconsistent findings with stroke mortality.[6,14,24] Two small studies in European populations did not find significant association between SRH
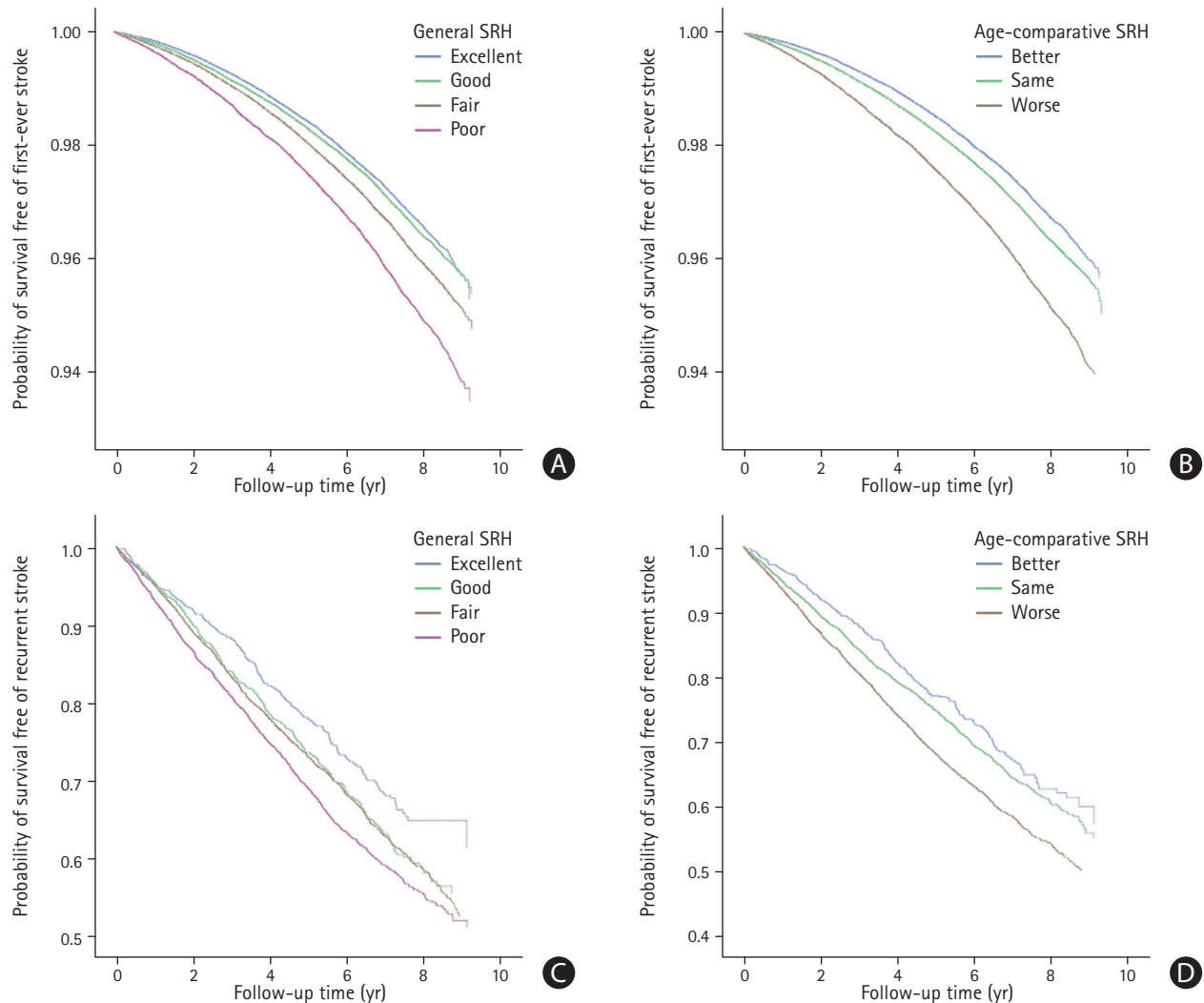
Figure 1. Survival and recurrence-free curves for participants according to self-rated health (SRH) categories. (A) First-ever stroke-free survival curves stratified by general SRH. (B) First-ever stroke-free survival curves stratified by age-comparative SRH. (C) Recurrence-free survival curves stratified by general SRH. (D) Recurrence-free survival curves stratified by age-comparative SRH. All survival curves were stratified by age (5 years intervals), sex, region (10 areas) and adjusted for age (continuous), marital status, education, annual household income, occupation, healthcare coverage, housing condition, menopausal status, sleep problems, cigarette smoking, alcohol drinking, physical activity (continuous), body mass index (continuous), family history of stroke, presence of baseline major depressive episodes, diabetes, hypertension, and other prevalent diseases (yes, no). The categories and definitions of all categorical variables were illustrated in the 'Covariates' section of the Methods.

and stroke mortality,[6,14] while a large study in US adults (n=689,710) reported a significant association (HR, 2.12 comparing poor with excellent SRH; 95% CI, 1.76 to 2.56).[24] The two European studies were also conducted in elderly populations (mean age, 74.1 and 76.2 years old),[6,14] while the US study[24] and our study were done in much younger participants (mean age, 44.4 and 51.0 years old). It was reported that the elders tend to rate their health more positively than their young counterparts; thus, SRH was a stronger predictor of mortality in younger than in older age groups.[25]

In addition to general SRH, we also identified significant associations between age-comparative SRH and stroke risk. It was argued that the general SRH question was mainly related

with health terms including function, youth, habits, and etc., and the age-comparative question was further connected to social performance, income, profession, and personal achievement; thus, the two measures may not be used interchangeably.[26] Our findings are consistent with two prior studies which also reported significant association between age-comparative SRH and stroke mortality.[6,9]

The associations between general SRH, age-comparative SRH, and stroke risk may be explained by several reasons. First, both general and age-comparative SRH are integrative assessment of overall health based on one's own perception on his or her objective health condition such as comorbidity,[27,28] disability,[29,30] and abnormal laboratory test results including hyperlip-

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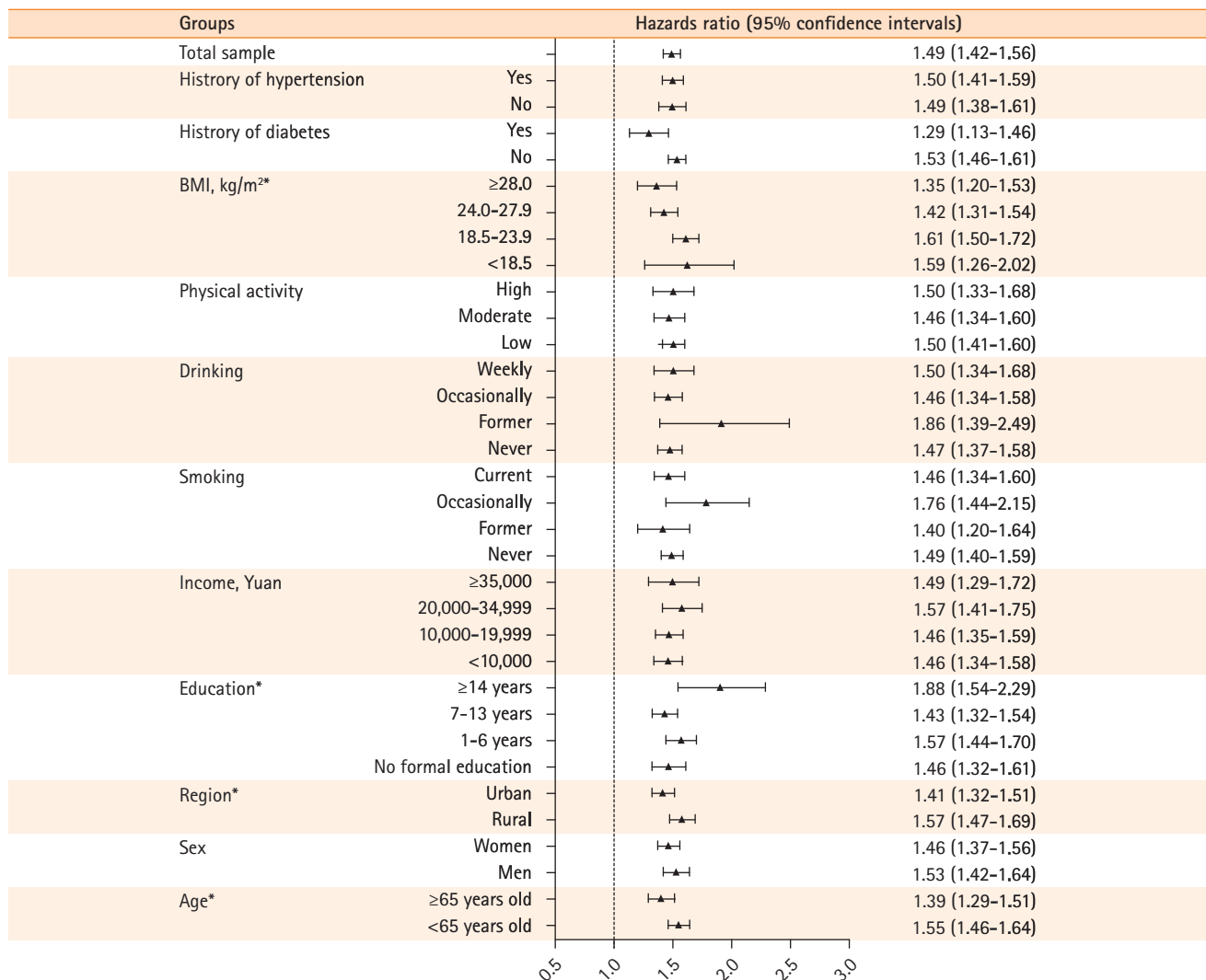| Groups		Hazards ratio (95% confidence intervals)
Total sample		1.49 (1.42–1.56)
History of hypertension	Yes	1.50 (1.41–1.59)
	No	1.49 (1.38–1.61)
History of diabetes	Yes	1.29 (1.13–1.46)
	No	1.53 (1.46–1.61)
BMI, kg/m²*	≥28.0	1.35 (1.20–1.53)
	24.0–27.9	1.42 (1.31–1.54)
	18.5–23.9	1.61 (1.50–1.72)
	<18.5	1.59 (1.26–2.02)
Physical activity	High	1.50 (1.33–1.68)
	Moderate	1.46 (1.34–1.60)
	Low	1.50 (1.41–1.60)
Drinking	Weekly	1.50 (1.34–1.68)
	Occasionally	1.46 (1.34–1.58)
	Former	1.86 (1.39–2.49)
	Never	1.47 (1.37–1.58)
Smoking	Current	1.46 (1.34–1.60)
	Occasionally	1.76 (1.44–2.15)
	Former	1.40 (1.20–1.64)
	Never	1.49 (1.40–1.59)
Income, Yuan	≥35,000	1.49 (1.29–1.72)
	20,000–34,999	1.57 (1.41–1.75)
	10,000–19,999	1.46 (1.35–1.59)
	<10,000	1.46 (1.34–1.58)
Education*	≥14 years	1.88 (1.54–2.29)
	7–13 years	1.43 (1.32–1.54)
	1–6 years	1.57 (1.44–1.70)
	No formal education	1.46 (1.32–1.61)
Region*	Urban	1.41 (1.32–1.51)
	Rural	1.57 (1.47–1.69)
Sex	Women	1.46 (1.37–1.56)
	Men	1.53 (1.42–1.64)
Age*	≥65 years old	1.39 (1.29–1.51)
	<65 years old	1.55 (1.46–1.64)

Figure 2. Stratified analysis: poor versus excellent general self-rated health and risk of first-ever stroke. The hazard ratios and 95% confidence intervals were calculated after stratification by age (5 years intervals), sex, region (10 areas) and adjustment for age (continuous), marital status, education, annual household income, occupation, healthcare coverage, housing condition, menopausal status, sleep problems, cigarette smoking, alcohol drinking, physical activity (continuous), body mass index (BMI) (continuous), family history of stroke, presence of baseline major depressive episodes, diabetes, hypertension, and other prevalent diseases (yes, no). The categories and definitions of all categorical variables were illustrated in the 'Covariates' section of the Methods. *$P_{interaction}$ <0.05.

idemia, hypertension, and hyperglycemia.[27,31] These health conditions reflect current overall health status and are predictive factors for future disease risk. Second, psychological factors such as depression and anxiety are not only reported to be determinants of SRH[27-29] but also significant risk factors for stroke.[32,33] Third, inflammation and genetic polymorphism may also play a role. In two recent studies,[31,34] poorer SRH was found to be significantly associated with elevated C-reactive protein independent of depression, neuroticism and objective health condition. According to a recent genome-wide association study of SRH among 111,749 participants from the UK Biobank study,[35] several genetic variants were found to be associated with both SRH and large vessel stroke.

Our study was a prospective population-based cohort study, and comprehensive health-related data collected at baseline allowing us to adjust for many covariates in statistical models. Additionally, our study was the first to examine the association between SRH measures and stroke subtypes, also the first to investigate the relationship of age-comparative SRH with risk of stroke morbidity. The study has several limitations as well. First, inaccurate responses to the questions due to poor understanding might exist. In our study, participants were from 10 geographically distant regions with different demographic and culture backgrounds, which might influence their choices of the answers. However, in stratified analyses, the associations were observed in all subgroups. Second, reverse causality bias was possi-

ble. However, we have excluded participants who died or developed stroke in the first 2 years after recruitment, positive associations persisted. Third, the confounding effect of objective health status may not be fully controlled in analyses. However, after excluding participants with cancer, CHD, and rheumatic heart disease in all analysis, and further exclusion of those with 13 chronic conditions in the sensitivity analyses, the associations remained significant. Finally, the severity of stroke, which might confound the association between SRH measures and stroke recurrence, was not measured in our study. Residual confounding due to factors such as air pollution, neuroticism, or anxiety might still exist, but not substantially change the results.

Conclusions

In our study, both general and age-comparative SRH were found to be independent predictors of incident stroke in Chinese, regardless of stroke subtypes or categories. Our findings suggest that on top of traditional risk factors of stroke, the two underutilized SRH measures may provide additional value on prediction of incident stroke. Healthcare providers in communities and physicians providing clinical care may use these simple, subjective, self-perceived questions to identify high-risk populations for prevention and intervention. The two measures of SRH may also be useful for public health practitioners, especially for those working in resource-limited settings. Nevertheless, whether the two SRH measures can be used in stroke risk prediction should be further confirmed in future studies, particularly for different populations.

Supplementary materials

Supplementary materials related to this article can be found online at https://doi.org/10.5853/jos.2017.01732.

Disclosure

The authors have no financial conflicts of interest.

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Supplementary Table 1. Baseline characteristics according to age-comparative self-rated health status

Characteristic	Total (n=471,551)	Age-comparative self-rated health		
		Better (n=90,738)	Same (n=309,022)	Worse (n=71,791)
Sociodemographic factor				
Age, mean±SD (yr)	50.9±10.5	50.8±10.7	50.9±10.5	51.4±10.5
Female sex (%)	58.9	54.0	58.8	65.6
Married (%)	91.0	91.1	91.4	89.0
No formal education (%)	18.6	14.3	18.6	24.1
Annual household income ≥35,000 Yuan (%)	17.8	20.3	18.3	12.7
Unemployed or not stated (%)	14.1	10.7	14.0	18.8
Healthcare coverage (%)	82.2	84.2	82.5	78.1
House/apartment owning (%)	44.7	39.3	47.7	38.9
Rural area (%)	57.7	45.4	61.0	58.8
Lifestyle factor				
Current regular smoker (%)	26.9	30.2	26.8	23.1
Weekly alcohol drinker (%)	15.3	20.5	14.8	10.5
Physical activity, mean±SD (MET-hr/day)	21.7±13.9	21.8±13.7	22.0±14.0	20.3±13.7
Sleep problems (%)	16.3	11.3	14.7	29.5
Personal/family medical history				
BMI, mean±SD (kg/m^2)	23.6±3.4	24.0±3.2	23.5±3.3	23.3±3.7
Postmenopausal (women only) (%)	50.4	47.0	49.9	55.7
Family history of stroke (%)	17.7	19.9	16.5	19.7
Prevalent diabetes (%)	5.3	3.7	4.8	9.6
Prevalent hypertension (%)	32.5	29.4	32.7	35.6
Prevalent major depression (%)	0.6	0.3	0.4	1.8
Other prevalent medical conditions (%)	22.8	18.4	19.7	35.3

Two-sided P-values were derived from ANOVA for continuous variables and from the chi-square test for categorical variables, all P-values comparing the difference between age-comparative self-rated health status groups <0.001.
SD, standard deviation; MET, metabolic equivalent; BMI, body mass index.

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Supplementary Table 2. Stratified analysis: association of general self-rated health status with risk of first-ever stroke

Subgroup	Cases/person-years	HR (95% CI)		P for interaction
		Model 1*	Model 2†	
Age				0.01
<65 years old				
Excellent	2,652/563,348	1.00	1.00	
Good	4,269/905,358	1.09 (1.04–1.15)	1.07 (1.02–1.13)	
Fair	8,438/1,277,830	1.31 (1.26–1.37)	1.23 (1.18–1.29)	
Poor	2,333/266,096	1.77 (1.67–1.87)	1.55 (1.46–1.64)	
≥65 years old				
Excellent	1,552/61,542	1.00	1.00	
Good	2,218/106,030	1.01 (0.94–1.07)	0.99 (0.93–1.06)	
Fair	4,894/199,043	1.17 (1.10–1.24)	1.12 (1.06–1.19)	
Poor	1,306/45,558	1.48 (1.37–1.60)	1.39 (1.29–1.51)	
Sex				0.18
Men				
Excellent	2,211/287,366	1.00	1.00	
Good	3,355/424,806	1.08 (1.02–1.14)	1.06 (1.00–1.12)	
Fair	6,085/566,892	1.27 (1.21–1.33)	1.20 (1.14–1.27)	
Poor	1,429/102,599	1.69 (1.57–1.81)	1.53 (1.42–1.64)	
Women				
Excellent	1,993/337,524	1.00	1.00	
Good	3,132/586,582	1.04 (0.98–1.10)	1.02 (0.96–1.08)	
Fair	7,247/909,981	1.24 (1.18–1.30)	1.17 (1.12–1.24)	
Poor	2,210/209,055	1.62 (1.53–1.73)	1.46 (1.37–1.56)	
Administrative region				0.03
Rural				
Excellent	1,499/276,278	1.00	1.00	
Good	3,916/650,391	1.11 (1.04–1.18)	1.09 (1.03–1.16)	
Fair	6,877/848,018	1.28 (1.20–1.35)	1.23 (1.16–1.30)	
Poor	2,221/202,093	1.72 (1.61–1.84)	1.57 (1.47–1.69)	
Urban				
Excellent	2,705/348,611	1.00	1.00	
Good	2,571/360,997	1.02 (0.97–1.08)	1.01 (0.95–1.06)	
Fair	6,455/628,855	1.24 (1.19–1.30)	1.18 (1.12–1.23)	
Poor	1,418/109,561	1.58 (1.48–1.69)	1.41 (1.32–1.51)	
Education				0.02
No formal education				
Excellent	706/94,554	1.00	1.00	
Good	1,683/212,177	1.15 (1.05–1.26)	1.13 (1.03–1.23)	
Fair	3,020/259,727	1.29 (1.19–1.41)	1.24 (1.14–1.35)	
Poor	1,058/76,866	1.58 (1.43–1.75)	1.46 (1.32–1.61)	
1–6 Years				
Excellent	1,175/163,094	1.00	1.00	
Good	2,238/327,233	1.05 (0.98–1.13)	1.04 (0.96–1.11)	
Fair	4,819/494,883	1.23 (1.15–1.31)	1.18 (1.11–1.26)	
Poor	1,338/110,533	1.71 (1.57–1.85)	1.57 (1.44–1.70)	

Supplementary Table 2. Continued

Subgroup	Cases/person-years	HR (95% CI)		P for interaction
		Model 1*	Model 2†	
7–13 Years				
Excellent	1,857/309,761	1.00	1.00	
Good	2,205/423,699	1.01 (0.94–1.07)	0.99 (0.93–1.05)	
Fair	4,706/645,620	1.24 (1.17–1.31)	1.17 (1.11–1.24)	
Poor	1,105/115,223	1.62 (1.50–1.74)	1.43 (1.32–1.54)	
≥14 Years				
Excellent	466/570,480	1.00	1.00	
Good	361/480,279	1.06 (0.92–1.22)	1.05 (0.92–1.21)	
Fair	733/760,645	1.34 (1.18–1.18)	1.26 (1.11–1.42)	
Poor	138/90,033	2.10 (1.72–2.55)	1.88 (1.54–2.29)	
Annually household income				0.26
<10,000 Yuan				
Excellent	1,097/137,948	1.00	1.00	
Good	1,993/267,558	1.02 (0.95–1.10)	1.01 (0.94–1.09)	
Fair	4,230/440,900	1.22 (1.14–1.31)	1.19 (1.11–1.27)	
Poor	1,650/142,713	1.57 (1.45–1.70)	1.46 (1.34–1.58)	
10,000–19,999 Yuan				
Excellent	1,338/166797	1.00	1.00	
Good	2,057/283519	1.05 (0.98–1.13)	1.03 (0.96–1.10)	
Fair	4,336/455769	1.21 (1.13–1.29)	1.14 (1.07–1.22)	
Poor	1,117/88313	1.64 (1.51–1.78)	1.46 (1.35–1.59)	
20,000–34,999 Yuan				
Excellent	1,052/172,835	1.00	1.00	
Good	1,405/259,438	1.07 (0.99–1.17)	1.06 (0.97–1.15)	
Fair	2,919/357,072	1.26 (1.17–1.35)	1.19 (1.10–1.28)	
Poor	594/50,429	1.77 (1.60–1.97)	1.57 (1.41–1.75)	
≥35,000 Yuan				
Excellent	744/147,310	1.00	1.00	
Good	1,032/200,872	1.12 (1.02–1.24)	1.11 (1.01–1.22)	
Fair	1,847/223,133	1.38 (1.27–1.51)	1.31 (1.19–1.43)	
Poor	278/30,198	1.66 (1.44–1.92)	1.49 (1.29–1.72)	
Cigarette smoking				0.84
Never				
Excellent	2,189/365,030	1.00	1.00	
Good	3,422/618,576	1.05 (1.00–1.11)	1.03 (0.98–1.09)	
Fair	7,810/951,585	1.25 (1.19–1.32)	1.19 (1.13–1.25)	
Poor	2,173/203,610	1.66 (1.56–1.76)	1.49 (1.40–1.59)	
Former				
Excellent	430/33,326	1.00	1.00	
Good	566/53,726	0.93 (0.81–1.05)	0.91 (0.80–1.04)	
Fair	1,126/76,128	1.14 (1.02–1.28)	1.09 (0.97–1.22)	
Poor	345/18,821	1.52 (1.30–1.77)	1.40 (1.20–1.64)	
Occasionally				
Excellent	230/37,473	1.00	1.00	

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Supplementary Table 2. Continued

Subgroup	Cases/person-years	HR (95% CI) Model 1*	Model 2†	P for interaction
Good	418/55,524	1.21 (1.02–1.42)	1.18 (1.00–1.39)	
Fair	765/84,760	1.36 (1.16–1.58)	1.29 (1.11–1.51)	
Poor	204/17,667	1.89 (1.55–2.30)	1.76 (1.44–2.15)	
Current				
Excellent	1,355/189,061	1.00	1.00	
Good	2,081/283,562	1.09 (1.01–1.16)	1.07 (1.00–1.15)	
Fair	3,631/364,402	1.27 (1.19–1.35)	1.20 (1.13–1.28)	
Poor	917/71,556	1.63 (1.50–1.78)	1.46 (1.34–1.60)	
Alcohol drinking				0.77
Never				
Excellent	1,572/250,324	1.00	1.00	
Good	2,629/459,511	1.02 (0.96–1.09)	1.00 (0.94–1.07)	
Fair	6,434/702,971	1.24 (1.17–1.31)	1.18 (1.11–1.25)	
Poor	1,885/156,670	1.62 (1.51–1.74)	1.47 (1.37–1.58)	
Former				
Excellent	71/5,849	1.00	1.00	
Good	154/11,445	1.24 (0.93–1.66)	1.22 (0.91–1.62)	
Fair	393/24,701	1.31 (1.01–1.70)	1.26 (0.97–1.64)	
Poor	183/9,695	1.96 (1.47–2.62)	1.86 (1.39–2.49)	
Occasionally				
Excellent	1526/234359	1.00	1.00	
Good	2315/351863	1.08 (1.01–1.15)	1.06 (0.99–1.13)	
Fair	4273/523762	1.24 (1.17–1.32)	1.18 (1.11–1.25)	
Poor	1091/103992	1.62 (1.5–1.76)	1.46 (1.34–1.58)	
Weekly				
Excellent	1,035/134,357	1.00	1.00	
Good	1,389/188,539	1.09 (1.00–1.18)	1.07 (0.99–1.17)	
Fair	2,232/225,440	1.28 (1.18–1.38)	1.21 (1.12–1.30)	
Poor	480/41,297	1.69 (1.51–1.89)	1.50 (1.34–1.68)	
Physical activity				0.93
Low				
Excellent	2,082/160,377	1.00	1.00	
Good	3,061/265,969	1.06 (1.01–1.13)	1.05 (0.99–1.11)	
Fair	7,429/503,983	1.27 (1.21–1.34)	1.22 (1.16–1.28)	
Poor	2,125/117,495	1.65 (1.55–1.76)	1.50 (1.41–1.60)	
Moderate				
Excellent	1,325/230,727	1.00	1.00	
Good	1,958/336,912	1.05 (0.98–1.13)	1.02 (0.95–1.10)	
Fair	3,749/496,385	1.23 (1.16–1.32)	1.16 (1.09–1.24)	
Poor	974/103,252	1.64 (1.50–1.79)	1.46 (1.34–1.60)	
High				
Excellent	797/233,785	1.00	1.00	
Good	1,468/408,507	1.05 (0.96–1.15)	1.04 (0.95–1.14)	
Fair	2,154/476,506	1.21 (1.11–1.32)	1.15 (1.06–1.26)	

Supplementary Table 2. Continued

Subgroup	Cases/person-years	HR (95% CI)		P for interaction
		Model 1*	Model 2†	
Poor	540/90,907	1.65 (1.47–1.85)	1.50 (1.33–1.68)	
BMI				0.03
<18.5 kg/m²				
Excellent	110/17,927	1.00	1.00	
Good	222/33,644	1.10 (0.87–1.39)	1.09 (0.86–1.37)	
Fair	638/71,607	1.28 (1.04–1.58)	1.25 (1.01–1.54)	
Poor	259/22,435	1.64 (1.30–2.08)	1.59 (1.26–2.02)	
18.5–23.9 kg/m²				
Excellent	1,769/322,794	1.00	1.00	
Good	2,981/535,202	1.07 (1.01–1.13)	1.05 (0.99–1.12)	
Fair	6,178/786,225	1.27 (1.20–1.34)	1.21 (1.15–1.28)	
Poor	1,701/163,605	1.76 (1.64–1.89)	1.61 (1.50–1.72)	
24.0–27.9 kg/m²				
Excellent	1,695/220,318	1.00	1.00	
Good	2,449/341,926	1.07 (1.01–1.14)	1.05 (0.99–1.12)	
Fair	4,688/470,278	1.25 (1.18–1.33)	1.18 (1.11–1.25)	
Poor	1,138/91,324	1.61 (1.49–1.74)	1.42 (1.31–1.54)	
≥28.0 kg/m²				
Excellent	630/63,850	1.00	1.00	
Good	835/100,615	1.00 (0.90–1.11)	0.98 (0.88–1.09)	
Fair	1,828/148,764	1.23 (1.12–1.35)	1.17 (1.06–1.28)	
Poor	541/34,291	1.51 (1.34–1.71)	1.35 (1.20–1.53)	
History of diabetes				0.09
No				
Excellent	3,793/604,066	1.00	1.00	
Good	5,894/974,658	1.06 (1.02–1.11)	1.05 (1.00–1.09)	
Fair	11,585/1,393,500	1.24 (1.19–1.29)	1.20 (1.15–1.25)	
Poor	2,941/282,054	1.62 (1.54–1.70)	1.53 (1.46–1.61)	
Yes				
Excellent	411/20,823	1.00	1.00	
Good	593/36,730	0.98 (0.86–1.12)	0.99 (0.87–1.12)	
Fair	1,747/83,374	1.13 (1.01–1.26)	1.12 (1.00–1.25)	
Poor	698/29,600	1.32 (1.17–1.50)	1.29 (1.13–1.46)	
History of hypertension				0.33
No				
Excellent	1,918/452,632	1.00	1.00	
Good	2,582/696,796	1.04 (0.98–1.11)	1.03 (0.97–1.10)	
Fair	5,069/990,674	1.19 (1.13–1.26)	1.16 (1.10–1.23)	
Poor	1,248/200,307	1.56 (1.45–1.69)	1.49 (1.38–1.61)	
Yes				
Excellent	2,286/172,258	1.00	1.00	
Good	3,905/314,592	1.05 (1.00–1.11)	1.05 (0.99–1.10)	

Supplementary Table 2. Continued

Subgroup	Cases/person-years	HR (95% CI)		P for interaction
		Model 1*	Model 2†	
Fair	8,263/486,200	1.23 (1.17–1.29)	1.21 (1.16–1.27)	
Poor	2,391/111,347	1.57 (1.48–1.67)	1.50 (1.41–1.59)	

HR, hazard ratio; CI, confidence interval; BMI, body mass index.
*Model 1: Stratified by age (5 years intervals), sex, region (10 areas) and adjusted for age (continuous), marital status, education, household annual income, occupation, healthcare coverage, housing condition, menopausal status, sleep problems, cigarette smoking, alcohol drinking, physical activity (continuous), body mass index (continuous), and family history of stroke; †Model 2: Model 1 plus presence of baseline major depressive episodes, diabetes, hypertension, and other comorbidities (yes, no). The categories and definitions of all categorical variables were illustrated in the 'Covariates' section of the Methods.

Supplementary Table 3. Stratified analysis: association of age-comparative self-rated health status with risk of first-ever stroke

Subgroup	Cases/person-years	HR (95% CI)		P for interaction
		Model 1*	Model 2†	
Age				0.15
<65 years old				
Better	2,933/569,076	1.00	1.00	
Same	10,792/1,920,839	1.22 (1.17–1.27)	1.16 (1.12–1.21)	
Worse	3,426/442,010	1.74 (1.65–1.83)	1.54 (1.46–1.62)	
≥65 years old				
Better	1,948/80,198	1.00	1.00	
Same	5,843/252,335	1.12 (1.06–1.18)	1.09 (1.03–1.15)	
Worse	1,695/60,516	1.57 (1.46–1.68)	1.48 (1.38–1.58)	
Sex				0.33
Men				
Better	2,639/295,957	1.00	1.00	
Same	8,006/882,687	1.19 (1.14–1.25)	1.14 (1.09–1.02)	
Worse	2,007/167,801	1.68 (1.58–1.79)	1.53 (1.44–1.63)	
Women				
Better	2,242/353,317	1.00	1.00	
Same	8,629/1,290,486	1.17 (1.11–1.22)	1.12 (1.07–1.18)	
Worse	3,114/334,724	1.65 (1.56–1.75)	1.50 (1.41–1.59)	
Administrative region				0.49
Rural				
Better	1,966/300,191	1.00	1.00	
Same	9,339/1,344,745	1.16 (1.10–1.22)	1.13 (1.08–1.19)	
Worse	2,927/297,984	1.64 (1.54–1.74)	1.52 (1.43–1.61)	
Urban				
Better	2,915/349,083	1.00	1.00	
Same	7,296/828,428	1.19 (1.14–1.24)	1.14 (1.09–1.19)	
Worse	2,194/204,542	1.67 (1.57–1.77)	1.50 (1.41–1.59)	
Education				<0.0001
No formal school				
Better	845/93,743	1.00	1.00	
Same	3,770/407,763	1.15 (1.06–1.24)	1.12 (1.04–1.21)	
Worse	1563/120,826	1.59 (1.45–1.73)	1.47 (1.35–1.61)	
1–6 Years				
Better	1,377/171,633	1.00	1.00	
Same	6,190/729,336	1.18 (1.11–1.25)	1.14 (1.07–1.21)	
Worse	1,685/162,048	1.66 (1.54–1.79)	1.52 (1.41–1.64)	
7–13 Years				
Better	2,123/325,179	1.00	1.00	
Same	5,793/928,181	1.18 (1.13–1.25)	1.13 (1.08–1.19)	
Worse	1,658/199,293	1.67 (1.56–1.79)	1.50 (1.40–1.60)	
≥14 Years				
Better	536/58,719	1.00	1.00	
Same	882/107,892	1.20 (1.07–1.34)	1.16 (1.04–1.29)	
Worse	215/20,359	2.07 (1.76–2.45)	1.85 (1.56–2.19)	

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Supplementary Table 3. Continued

Subgroup	Cases/person-years	HR (95% CI)		P for interaction
		Model 1*	Model 2[†]	
Annual household income				<0.0001
<10,000 Yuan				
Better	1,466/179,416	1.00	1.00	
Same	5,045/579,784	1.14 (1.07–1.21)	1.12 (1.05–1.18)	
Worse	2,182/203,974	1.58 (1.47–1.69)	1.47 (1.37–1.58)	
10,000–19,999 Yuan				
Better	1,561/186,844	1.00	1.00	
Same	5,470/639,557	1.18 (1.11–1.25)	1.13 (1.06–1.2)	
Worse	1,547/140,039	1.64 (1.52–1.76)	1.48 (1.37–1.59)	
20,000–34,999 Yuan				
Better	1,051/155,223	1.00	1.00	
Same	3,773/566,785	1.20 (1.12–1.29)	1.14 (1.06–1.22)	
Worse	916/9,6324	1.82 (1.66–2.00)	1.62 (1.48–1.78)	
≥35,000 Yuan				
Better	803/127,792	1.00	1.00	
Same	2,347/387,047	1.21 (1.11–1.32)	1.16 (1.07–1.27)	
Worse	476/62,189	1.70 (1.51-1.91)	1.52 (1.34–1.71)	
Cigarette smoking				0.001
Never				
Better	2,439/374,729	1.00	1.00	
Same	9,380/1,364,521	1.19 (1.14–1.25)	1.15 (1.10–1.20)	
Worse	3,106/332,251	1.70 (1.61–1.80)	1.54 (1.46–1.63)	
Former				
Better	498/37,911	1.00	1.00	
Same	1,416/110,842	1.17 (1.06–1.31)	1.14 (1.02–1.27)	
Worse	476/28,582	1.71 (1.50–1.96)	1.59 (1.38–1.82)	
Occasionally				
Better	342/41,685	1.00	1.00	
Same	950/120,277	1.13 (0.99–1.29)	1.09 (0.96–1.24)	
Worse	267/27,851	1.59 (1.34–1.88)	1.50 (1.26–1.78)	
Current				
Better	1,602/194,949	1.00	1.00	
Same	4,889/577,533	1.17 (1.10–1.24)	1.12 (1.05–1.19)	
Worse	1,272/113,842	1.59 (1.47–1.72)	1.44 (1.33–1.56)	
Alcohol drinking				<0.001
Never				
Better	1,530/227,108	1.00	1.00	
Same	7,618/1,028,927	1.24 (1.17–1.32)	1.20 (1.13–1.27)	
Worse	2,716/254,234	1.78 (1.66–1.90)	1.62 (1.51–1.73)	
Former				
Better	84/6,686	1.00	1.00	
Same	451/29,899	1.19 (0.93–1.52)	1.15 (0.90–1.46)	
Worse	228/13,500	1.76 (1.35–2.29)	1.66 (1.27–2.17)	
Occasionally				

Supplementary Table 3. Continued

Subgroup	Cases/person-years	HR (95% CI)		P for interaction
		Model 1*	Model 2[†]	
Better	1,971/266,866	1.00	1.00	
Same	5,546/753,542	1.15 (1.10–1.22)	1.11 (1.06–1.18)	
Worse	1,489/167,770	1.59 (1.48–1.71)	1.44 (1.34–1.55)	
Weekly				
Better	1,296/148,614	1.00	1.00	
Same	3,020/360,804	1.12 (1.05–1.20)	1.07 (1.00–1.15)	
Worse	699/67,021	1.56 (1.42–1.72)	1.42 (1.29–1.56)	
Physical activity				0.88
Low				
Better	2,463/182,125	1.00	1.00	
Same	8,747/654,218	1.20 (1.14–1.25)	1.15 (1.10–1.20)	
Worse	2,855/170,798	1.69 (1.59–1.78)	1.54 (1.45–1.63)	
Moderate				
Better	1,538/240,492	1.00	1.00	
Same	4,763/722,904	1.15 (1.08–1.22)	1.11 (1.05–1.18)	
Worse	1,412/168,729	1.63 (1.51–1.76)	1.47 (1.36–1.59)	
High				
Better	880/226,657	1.00	1.00	
Same	3,125/796,052	1.17 (1.08–1.26)	1.14 (1.05–1.23)	
Worse	854/162,998	1.62 (1.47–1.79)	1.49 (1.35–1.65)	
BMI				0.22
<18.5 kg/m^2				
Better	127/15,751	1.00	1.00	
Same	696/90,223	1.06 (0.87–1.30)	1.07 (0.88–1.31)	
Worse	345/33,726	1.45 (1.17–1.80)	1.44 (1.16–1.80)	
18.5–23.9 kg/m^2				
Better	1,998/319,646	1.00	1.00	
Same	7,818/1,168,853	1.21 (1.15–1.27)	1.17 (1.11–1.23)	
Worse	2,325/266,943	1.71 (1.60–1.82)	1.56 (1.46–1.66)	
24.0–27.9 kg/m^2				
Better	1,986/240,072	1.00	1.00	
Same	5,937/705,406	1.18 (1.12–1.25)	1.13 (1.08–1.20)	
Worse	1,667/146,475	1.71 (1.60–1.83)	1.53 (1.42–1.64)	
≥28.0 kg/m^2				
Better	770/73,806	1.00	1.00	
Same	2,184/208,681	1.11 (1.02–1.21)	1.07 (0.98–1.17)	
Worse	784/55,382	1.57 (1.41–1.74)	1.42 (1.28–1.58)	
History of diabetes				0.43
No				
Better	4,431/626,593	1.00	1.00	
Same	14,764/2,075,542	1.17 (1.13–1.21)	1.14 (1.10–1.18)	
Worse	4,137/458,445	1.61 (1.54–1.68)	1.53 (1.47–1.60)	
Yes				
Better	450/22,681	1.00	1.00	

Supplementary Table 3. Continued

| Subgroup | Cases/person-years | HR (95% CI) | | *P* for interaction |
		Model 1*	Model 2†	
Same	1,871/97,632	1.12 (1.01–1.25)	1.11 (1.00–1.23)	
Worse	984/44,081	1.43 (1.28–1.61)	1.40 (1.25–1.58)	
History of hypertension				0.07
No				
Better	2,130/462,339	1.00	1.00	
Same	6,460/1,481,015	1.16 (1.10–1.22)	1.14 (1.09–1.20)	
Worse	1778/330,834	1.58 (1.48–1.68)	1.50 (1.41–1.61)	
Yes				
Better	2,751/186,935	1.00	1.00	
Same	10,175/692,158	1.15 (1.10–1.20)	1.13 (1.09–1.18)	
Worse	3,343/171,692	1.59 (1.50–1.67)	1.52 (1.44–1.61)	

HR, hazard ratio; CI, confidence interval; BMI, body mass index.
*Model 1: Stratified by age (5 years intervals), sex, region (10 areas) and adjusted for age (continuous), marital status, education, household annual income, occupation, healthcare coverage, housing condition, menopausal status, sleep problems, cigarette smoking, alcohol drinking, physical activity (continuous), body mass index (continuous), and family history of stroke; †Model 2: Model 1 plus presence of baseline major depressive episodes, diabetes, hypertension, and other comorbidities (yes, no). The categories and definitions of all categorical variables were illustrated in the 'Covariates' section of the Methods.

Supplementary Table 4. Sensitivity analysis: association of self-rated health status measures with risk of first-ever stroke*

Outcome categories	Exposure categories	HR (95% CI)		
		No major depression episodes[†]	No comorbidities[‡]	Not died or developed stroke in the first 2 years[§]
First-ever stroke	General SRH			
	Excellent	1.00	1.00	1.00
	Good	1.04 (1.00–1.08)	1.07 (1.00–1.16)	1.03 (0.99–1.08)
	Fair	1.19 (1.15–1.23)	1.20 (1.12–1.28)	1.18 (1.13–1.23)
	Poor	1.49 (1.42–1.56)	1.55 (1.40–1.71)	1.43 (1.36–1.51)
	Age-comparative SRH			
	Better	1.00	1.00	1.00
	Same	1.13 (1.09–1.17)	1.18 (1.11–1.26)	1.11 (1.07–1.16)
	Worse	1.51 (1.45–1.58)	1.54 (1.41–1.68)	1.44 (1.38–1.51)
Hemorrhagic stroke	General SRH			
	Excellent	1.00	1.00	1.00
	Good	1.09 (0.99–1.20)	1.01 (0.84–1.23)	1.06 (0.95–1.18)
	Fair	1.18 (1.08–1.29)	1.11 (0.93–1.33)	1.16 (1.05–1.28)
	Poor	1.62 (1.45–1.80)	1.47 (1.15–1.89)	1.52 (1.34–1.72)
	Age-comparative SRH			
	Better	1.00	1.00	1.00
	Same	1.14 (1.05–1.24)	1.26 (1.06–1.50)	1.14 (1.04–1.25)
	Worse	1.57 (1.43–1.73)	1.68 (1.34–2.10)	1.49 (1.34–1.66)
Ischemic stroke	General SRH			
	Excellent	1.00	1.00	1.00
	Good	1.03 (0.99–1.08)	1.08 (0.99–1.16)	1.03 (0.98–1.08)
	Fair	1.20 (1.15–1.24)	1.22 (1.13–1.31)	1.18 (1.13–1.24)
	Poor	1.45 (1.38–1.53)	1.51 (1.36–1.69)	1.40 (1.32–1.49)
	Age-comparative SRH			
	Better	1.00	1.00	1.00
	Same	1.14 (1.10–1.18)	1.17 (1.09–1.25)	1.12 (1.08–1.16)
	Worse	1.49 (1.43–1.57)	1.48 (1.34–1.63)	1.43 (1.36–1.51)
Fatal stroke	General SRH			
	Excellent	1.00	1.00	1.00
	Good	1.06 (0.94–1.20)	1.16 (0.91–1.48)	1.05 (0.92–1.20)
	Fair	1.27 (1.14–1.42)	1.23 (0.98–1.55)	1.28 (1.13–1.46)
	Poor	1.91 (1.68–2.18)	2.16 (1.62–2.88)	1.86 (1.60–2.15)
	Age-comparative SRH			
	Better	1.00	1.00	1.00
	Same	1.17 (1.06–1.29)	1.28 (1.04–1.58)	1.16 (1.04–1.29)
	Worse	1.81 (1.61–2.03)	1.97 (1.52–2.55)	1.70 (1.50–1.94)

Supplementary Table 4. Continued

Outcome categories	Exposure categories	HR (95% CI)		
		No major depression episodes[†]	No comorbidities[‡]	Not died or developed stroke in the first 2 years[§]
Non-fatal stroke	General SRH			
	Excellent	1.00	1.00	1.00
	Good	1.04 (1.00–1.08)	1.06 (0.98–1.14)	1.03 (0.98–1.08)
	Fair	1.18 (1.14–1.23)	1.20 (1.12–1.29)	1.17 (1.12–1.22)
	Poor	1.43 (1.36–1.51)	1.48 (1.33–1.65)	1.38 (1.30–1.46)
	Age-comparative SRH			
	Better	1.00	1.00	1.00
	Same	1.13 (1.09–1.17)	1.17 (1.10–1.25)	1.11 (1.07–1.15)
	Worse	1.47 (1.40–1.54)	1.49 (1.35–1.63)	1.41 (1.34–1.48)

HR, hazard ratio; CI, confidence interval; SRH, self-rated health status.

*HR (95% CI) were calculated after stratification by age (5 years intervals), sex, region (10 areas) and adjustment for age (continuous), marital status, education, annual household income, occupation, healthcare coverage, housing condition, menopausal status, sleep problems, cigarette smoking, alcohol drinking, physical activity (continuous), body mass index (continuous), family history of stroke, presence of baseline major depressive episodes, diabetes, hypertension and other prevalent diseases (yes, no). The categories and definitions of all categorical variables were illustrated in the 'Covariates' section of the Methods; [†]2,972 participants with baseline major depression episodes were excluded and 483,569 remained for analysis; [‡]238,007 participants with baseline comorbidities were excluded and 248,534 remained for analysis; [§]8,216 participants who died or developed stroke in the first 2 years of follow-up were excluded and 478,325 remained for analysis.

Supplementary Table 5. Incorporating two measures in one model: association of SRH status measures with risk of first-ever stroke

Outcome categories	Exposures	HR (95% CI)		
		A*	B†	C‡
Total stroke	General SRH (reference=excellent)			
	Good	1.04 (1.00–1.08)		1.01 (0.97–1.06)
	Fair	1.19 (1.15–1.23)		1.11 (1.06–1.15)
	Poor	1.49 (1.42–1.56)		1.21 (1.14–1.29)
	Age-comparative SRH (reference=better)			
	Same		1.13 (1.10–1.17)	1.09 (1.05–1.13)
	Worse		1.52 (1.46–1.58)	1.34 (1.27–1.42)
Hemorrhagic stroke	General SRH (reference=excellent)			
	Good	1.09 (0.99–1.20)		1.06 (0.95–1.17)
	Fair	1.18 (1.08–1.29)		1.09 (0.98–1.20)
	Poor	1.62 (1.46–1.81)		1.30 (1.14–1.50)
	Age-comparative SRH (reference=better)			
	Same		1.14 (1.05–1.23)	1.10 (1.00–1.20)
	Worse		1.57 (1.43–1.73)	1.35 (1.20–1.53)
Ischemic stroke	General SRH (reference=excellent)			
	Good	1.03 (0.99–1.08)		1.01 (0.96–1.05)
	Fair	1.20 (1.15–1.25)		1.12 (1.07–1.17)
	Poor	1.45 (1.38–1.53)		1.19 (1.11–1.27)
	Age-comparative SRH (reference=better)			
	Same		1.14 (1.10–1.18)	1.09 (1.05–1.13)
	Worse		1.50 (1.43–1.57)	1.34 (1.26–1.42)
Fatal stroke	General SRH (reference=excellent)			
	Good	1.06 (0.94–1.20)		1.02 (0.90–1.16)
	Fair	1.27 (1.13–1.42)		1.15 (1.01–1.31)
	Poor	1.92 (1.69–2.19)		1.47 (1.25–1.74)
	Age-comparative SRH (reference=better)			
	Same		1.17 (1.06–1.29)	1.10 (0.98–1.23)
	Worse		1.82 (1.63–2.04)	1.43 (1.23–1.66)
Non-fatal stroke	General SRH (reference=excellent)			
	Good	1.04 (1.00–1.08)		1.01 (0.97–1.06)
	Fair	1.18 (1.14–1.23)		1.11 (1.06–1.15)
	Poor	1.43 (1.36–1.51)		1.18 (1.10–1.25)
	Age-comparative SRH (reference=better)			
	Same		1.13 (1.09–1.17)	1.08 (1.04–1.13)
	Worse		1.47 (1.41–1.54)	1.33 (1.25–1.40)

SRH, self-rated health; HR, hazard ratio; CI, confidence interval.

*Only general SRH was included in Model 2 (stratified by age [5 years intervals], sex, region [10 areas] and adjusted for age [continuous], marital status, education, annual household income, occupation, healthcare coverage, housing condition, menopausal status, sleep problems, cigarette smoking, alcohol drinking, physical activity [continuous], body mass index [continuous], family history of stroke, presence of baseline major depressive episodes, diabetes, hypertension, and other prevalent diseases [yes, no]). The categories and definitions of all categorical variables were illustrated in the 'Covariates' section of the Methods; †Only age-comparative SRH was included in Model 2; ‡Both general SRH and age-comparative SRH were included in Model 2.
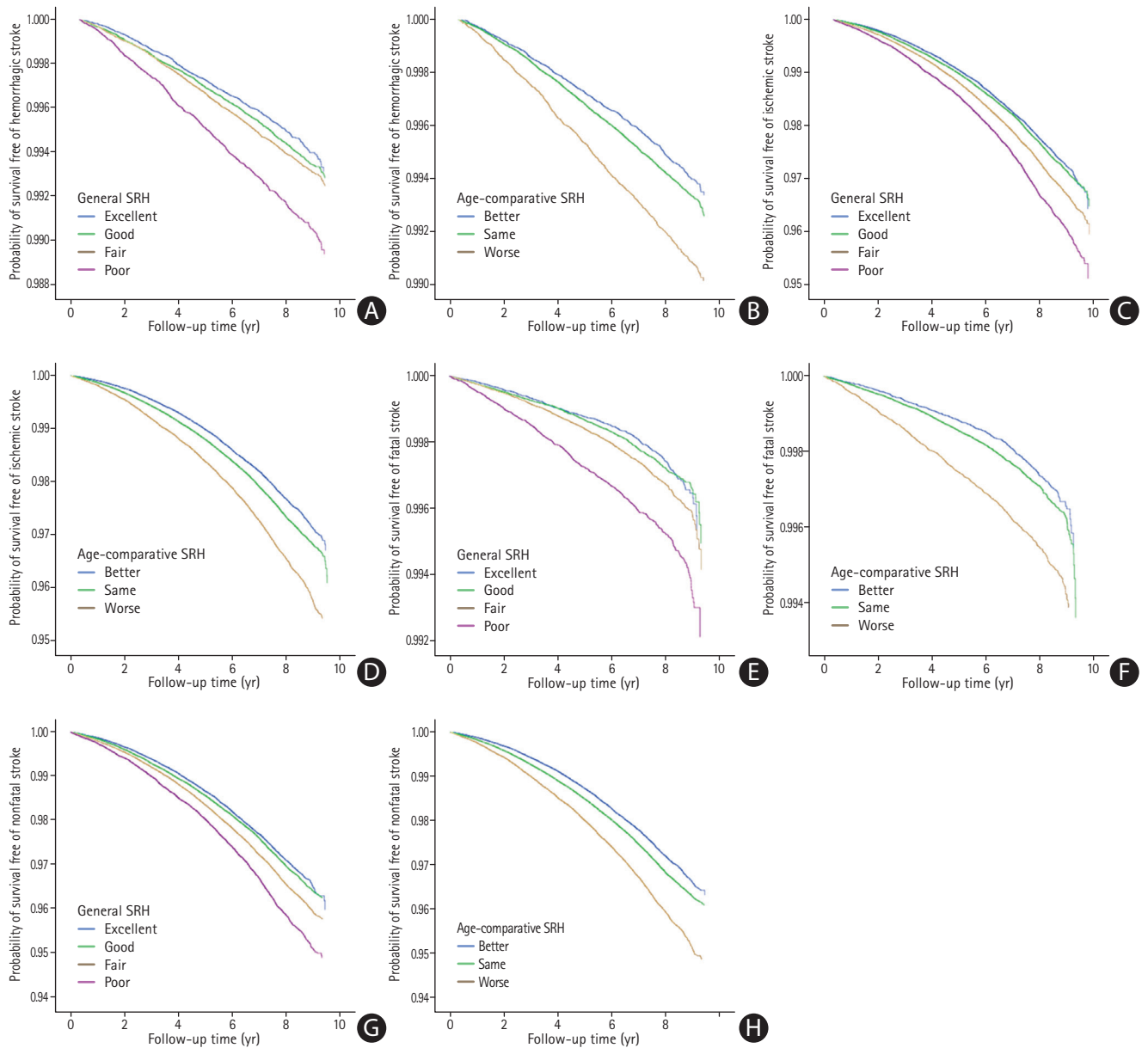
Supplemental Figure 1. Survival curves for participants according to self-rated health (SRH) categories. (A) Survival curves free of hemorrhagic stroke stratified by general SRH. (B) Survival curves free of hemorrhagic stroke stratified by age-comparative SRH. (C) Survival curves free of ischemic stroke stratified by general SRH. (D) Survival curves free of ischemic stroke stratified by age-comparative SRH. (E) Survival curves free of fatal stroke stratified by general SRH. (F) Survival curves free of fatal stroke stratified by age-comparative SRH. (G) Survival curves free of non-fatal stroke stratified by general SRH. (H) Survival curves free of non-fatal stroke stratified by age-comparative SRH. All survival curves were stratified by age (5 years intervals), sex, region (10 areas) and adjusted for age (continuous), marital status, education, annual household income, occupation, healthcare coverage, housing condition, menopausal status, sleep problems, cigarette smoking, alcohol drinking, physical activity (continuous), body mass index (continuous), family history of stroke, presence of baseline major depressive episodes, diabetes, hypertension, and other prevalent diseases (yes, no). The categories and definitions of all categorical variables were illustrated in the 'Covariates' section of the Methods.