


BMJ Open Public knowledge of stroke and heart attack symptoms in China: a cross-sectional survey

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ABSTRACT

Objective Stroke and ischaemic heart disease have become the leading causes of death in China. We evaluated recognition of stroke and heart attack symptoms and stroke treatment-seeking behaviour in a large representative sample of the Chinese adult population and explored characteristics associated with recognition rates.

Design Cross-sectional survey.

Setting Household interviews.

Participant 3051 Chinese adults aged between 18 and 69 (50.7% female) were interviewed between January and March 2019.

Primary and secondary outcome measures Primary measures include recognitions of stroke and heart attack symptoms and stroke treatment-seeking behaviour. Secondary measures include numeracy level, sociodemographics and prior history of cardiovascular diseases and high blood pressure.

Results Participants on average recognised 5.2 out of 14 stroke symptoms and 2.6 out of 6 heart attack symptoms. In the presence of stroke symptoms, three quarters of participants would take immediate action and call an ambulance, yet the second most common action was to advise the person to see a doctor (59%) rather than to consult a doctor immediately (34%). Recognition of atypical heart attack symptoms, such as nausea and feeling of anxiety, was poor. Symptom recognition rates were higher in females, people with a personal or family/friend history of cardiovascular events, those with higher numeracy scores, and for stroke symptoms, participants with high (versus low) education level. Furthermore, symptom recognition rate was negatively correlated with burden of cardiovascular diseases across the four economic regions of China.

Conclusion Recognition of stroke and heart-attack symptoms was moderate and there remains a gap between recognising symptoms and taking immediate action. Interventions focusing on simple symptom detection tools and on building numerical competencies may help reduce the burden of cardiovascular diseases in China.

INTRODUCTION

Cardiovascular diseases (CVDs) continue to be major causes of death worldwide.¹ In 2017, stroke and ischaemic heart disease were the leading causes of death in China, with 149 and 124 in every 100 000 people dying

Strengths and limitations of this study

- This study provides the first assessment of stroke and heart attack symptom knowledge and stroke treatment-seeking behaviour in a representative sample of the general adult population in Mainland China.
- In addition to sociodemographic factors and prior medical history, this study also examined how participants' levels of numeracy, the ability to comprehend and use information about numbers, affected symptom recognition.
- People living in rural communities and older adults with higher risks of cardiovascular diseases were likely under-represented in the study sample.
- Responses to heart attack symptoms were not assessed.

from stroke and heart attack, respectively.² Lifestyle factors account for increases in the burden of CVD in China,^{2 3} and modifiable risk factors account for around 90% of population attributable risks for stroke worldwide.⁴ For instance, higher sodium and lower fat intakes in Asian countries are associated with stroke incidence and mortality rates being higher than other CVDs relative to Western countries.³ Numerous efforts promoting the prevention and treatment of CVDs have been undertaken in China in recent years,⁵ such as the China National Plan on Non-communicable Disease Prevention and Treatment (2012–2015) and the Healthy China 2030 Plan,⁶ to curb the increasing prevalence of non-communicable and chronic diseases.

In addition to promoting healthy lifestyles and expanding healthcare services, reducing the burden of CVDs requires that patients suffering from symptoms get rapid access to treatment. Long delays between symptom onset and arrival at hospital mean that patients may arrive too late to receive treatments that are most effective when administered within a limited time window.^{7 8} The largest contributor to delays in treatment, particularly for stroke, are prehospital delays,^{9 10} over half of

which are caused by hesitation to call medical services.¹¹ Symptom recognition is an important precursor to treatment-seeking behaviour, and a mismatch between expected and experienced symptoms, or not perceiving symptoms as severe, contributes to delays.¹⁰ However, in China, less than a quarter of acute stroke patients could recognise relevant warning signs of stroke at discharge from hospital,¹² and people at higher risk of stroke do not recognise more stroke symptoms—neither do they have higher tendency to call emergency medical services—than those with lower risks.¹³

A recent review on recall of stroke warning signs found that while many people could name at least one warning sign for stroke, the percentage of people who could name more than one was low.¹⁴ When asked about symptom recognition rather than recall, participants from a representative sample of nine European countries could on average recognise only 3.3 out of 14 stroke symptoms, and no symptoms were recognised by more than 50% of the sample.¹⁵ Older and more educated participants tended to recognise more symptoms, and women recognised more symptoms than men. This lack of symptom recognition affected treatment-seeking behaviour: only 51% of participants indicated that they would call an ambulance if someone was suffering from multiple stroke symptoms.

With respect to heart attack symptoms, participants from the same European study recognised only 2.3 out of 6 possible symptoms on average, and older adults, females and more educated participants recognised more symptoms.¹⁵ A study of older Hong Kong residents found that more than 50% identified chest pain, shortness of breath, and dizziness as symptoms, and one-third recognised at least five of nine heart attack symptoms.⁸ Moreover, a survey of Beijing and Shanghai residents¹⁶ found that 15%–18% could not name even one heart attack symptom and the identification rates for other symptoms were lower than those reported in other studies,^{8 15} possibly because participants were asked to recall rather than recognise symptoms.

Gauging public knowledge of stroke and heart attack symptoms can inform health organisations about potential knowledge gaps and identify areas to target for improvement. We examine sociodemographic characteristics associated with stroke and heart attack recognition in China, as found in other countries.^{8 14–16} Importantly, we control for province-level disability-adjusted life years (DALYs) for stroke and ischaemic heart disease to account for differences in disease burden across China (eg, DALYs tend to be higher in provinces with lower economic performance).² We also examine the relationship between symptom recognition and numeracy, the ability to comprehend and use information about numbers.^{17 18} Health materials frequently include numerical information. In our own overview of stroke and heart attack information materials provided by government and health organisations in China, approximately 70% incorporated numerical information (see online supplemental table S1). Numeracy skills are considered an important

component of health literacy, affecting people's ability to understand health information, and higher numeracy skills are associated with more informed decisions and improved health outcomes.^{17 19} Therefore, we explore whether numeracy skills can account for differences in stroke and heart attack symptom recognition rates beyond sociodemographic factors.

METHOD

Household survey

The data were collected as part of the China Health Risk and Knowledge survey conducted between January and March 2019. The survey was a structured household survey of a representative sample of 3051 Chinese adults aged between 18 and 69. The sample is based on a probability sample of households from four major economic regions of Mainland China: Northeastern, Eastern, Central and Western (online supplemental figure S1).²⁰ The sample size for each region was determined according to the proportion of its population in Mainland China. Over-sampling of the Northeastern region was undertaken to reduce sampling errors caused by its relatively small population size. The planned (vs actual) sample sizes for each economic region were 400 (406) for Northeastern, 1150 (1167) Eastern, 740 (749) Central and 710 (729) Western, respectively.

Within each region, three levels of cities were selected as the sampling frame: prefecture, county and town. Different numbers of cities were selected at each level, so that the sample size at each level would match its proportion in the total population of that region (online supplemental table S2) reports cities and sample sizes and (online supplemental figure S2) shows a heatmap of the relative sample sizes for sampled cities). Residential blocks were selected based on population density and representativeness. Interviewers started at a random location within each block and chose a household close to a main road. After refusal or successful data collection, interviewers used the right-hand rule to select a household that was at least five residential units away from the previous one. One individual per household was interviewed. Interviewers sampled until the age-sex quota for the city was met. The proportion of each sex, age and education stratum in the final sample relative to the population of Mainland China are shown in online supplemental tables 3,4). Strengthening the Reporting of Observational Studies in Epidemiology guideline was used for reporting of cross-sectional studies.²¹

Study procedure and measures

Interviews were conducted face to face with questions read from a portable tablet that also recorded participant responses. A full interview was conducted when participants agreed to participate, were aged between 18 and 69, had lived in their residential city for more than 1 year, and had not taken part in any survey study in the past 6 months. Participants were informed about the purpose

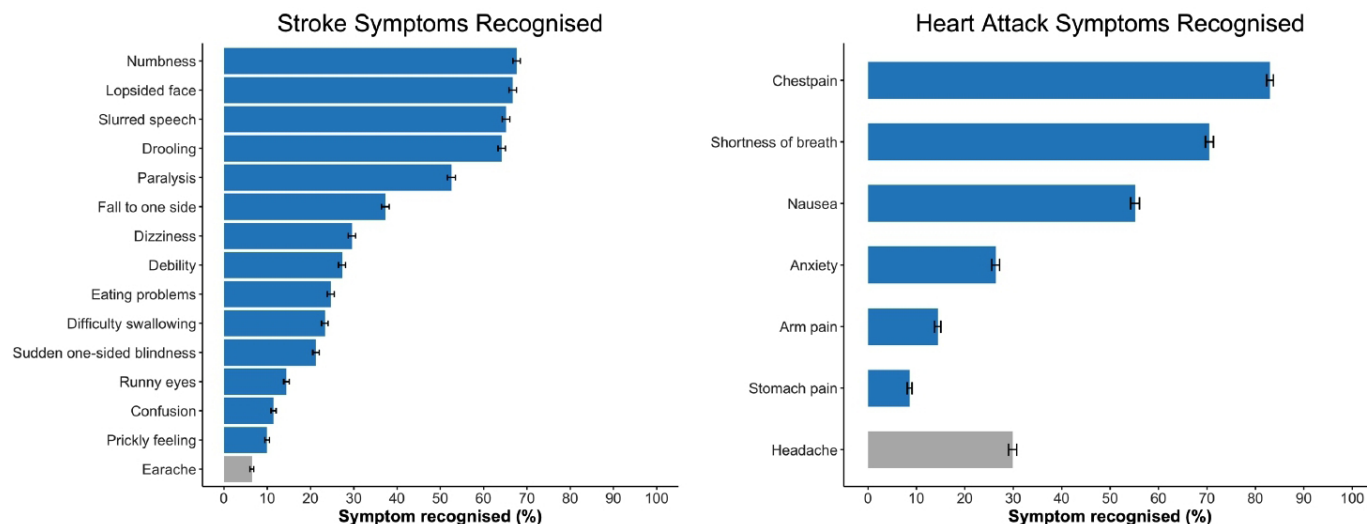


Figure 1 Percentage of participants who recognised each symptom for stroke and heart attack. Weighted percentages. Error bars represent SEs. Grey bars refer to symptoms that are not associated with stroke or heart attack.

of the survey and told they could stop at any time without negative consequences.

Participants provided sociodemographic information, including age, sex, education, prior history of heart attack or stroke—personal and in family members and friends—and whether they had been told by their doctor that they had high blood pressure, and answered items assessing numeracy, stroke and heart attack symptom knowledge and stroke actions. Numeracy was measured with the three-item Schwartz numeracy test,¹⁸ which was translated into Chinese with minor changes made for cultural relevance. Items of symptom knowledge and stroke actions were taken from Mata *et al*¹⁵ and translated into Chinese. Two Chinese cardiology doctors were consulted to ensure that translations were correct and conformed to terms typically used in Chinese medical settings.

For stroke, the items include 14 symptoms medically associated with stroke and one that was not (earache); and for heart attack, there were six medically associated symptoms and one that was not (headache; see figure 1 for the lists of symptoms). Participants were asked to check all symptoms that they thought were valid signs of stroke and heart attack, respectively. For stroke actions, participants were asked what they would do if they saw a person suffering from impaired vision, speech problems, numbness or one-sided debility, all of which are symptoms of stroke. Participants were provided with five possible actions and could choose any number of them (see figure 2 for the list of actions).

All the survey questions and data related to the analyses and results reported in this study are available and can be accessed at <https://osf.io/vfm8j>. Data related to other survey questions will be analysed and reported elsewhere.

Patient and public involvement

This research was done without patient involvement. Patients were not invited to comment on the study design, nor contribute to the writing or editing of the paper.

Cardiology doctors who had no financial or other interests in study outcomes were consulted on survey design and dissemination plan.

Analysis

Data on heart attack and stroke symptom knowledge, stroke actions and numeracy are described in terms of weighted percentages or averages for the sample. Post-stratification weights based on age group and sex for each economic region were applied using data from the Chinese National Bureau of Statistics. Weights were calculated with an iterative proportional fitting (raking) procedure.

A linear mixed-effects model treating province as a random effect was used to identify characteristics associated with knowledge of stroke and heart attack symptoms (ie, age, sex, education, history of CVD and high blood pressure, and numeracy) and province-level DALYs (see the statistics in online supplemental table S5) were included as fixed effects. Analyses were conducted using R (V.3.5.2) (online supplemental table S6) shows correlations among main study variables.

RESULTS

Sample

Sociodemographics of the study sample can be found in online supplemental table S7 for weighted and unweighted results. Around 11% of the sample reported that their doctor had told them that they had high blood pressure, 7.2% indicated having a personal history of heart attack, stroke or other CVDs, and 52.5% reported knowing a family member or friend who had suffered from such diseases. The average number of numeracy items answered correctly was 1.39 (SE=0.02; 95% CI 1.35 to 1.42), with 43.9% of participants answering at least two of the three items correctly.

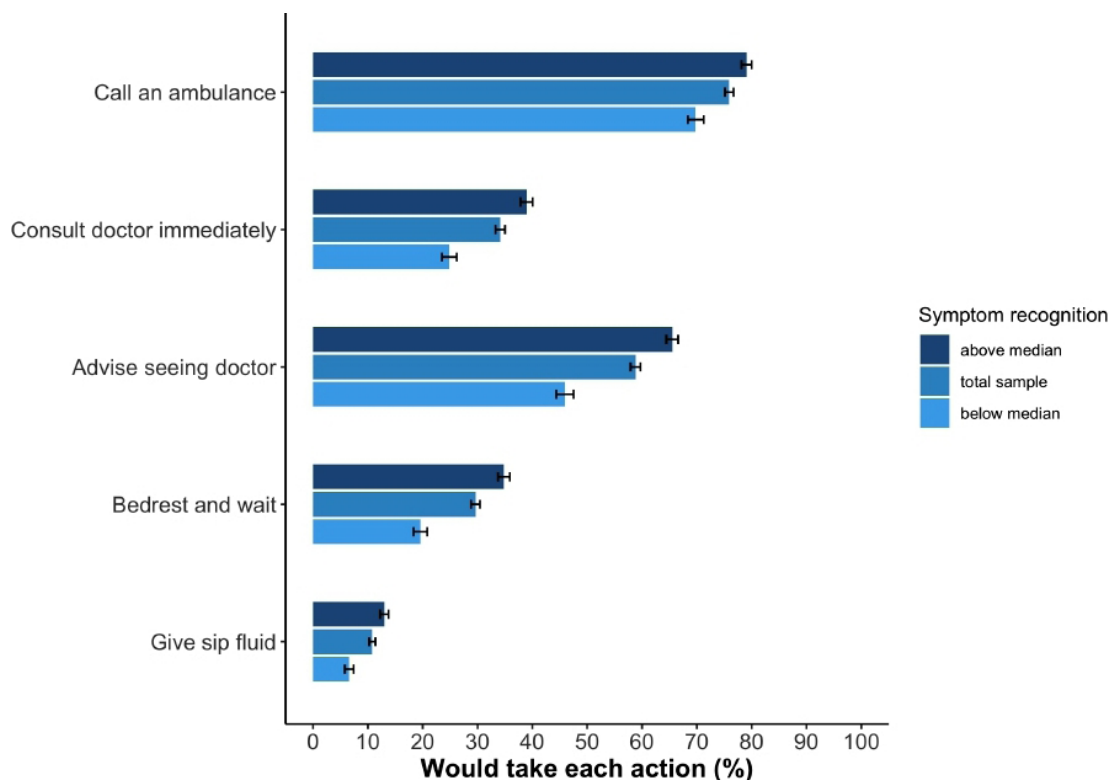


Figure 2 Percentage of participants who would take each of the listed actions if they saw a person suffering from stroke symptoms. Weighted means. Error bars represent SEs. Middle bars show results for the entire sample, with bars on either side representing percentages for participants who recognised either above or below the median number of stroke symptoms.

Stroke symptom recognition

The percentage of participants who recognised each stroke symptom is presented in figure 1. Over half of the sample recognised numbness (67.6%), lopsided face (66.7%), slurred speech (65.2%), spit running out of the mouth (64.2%) and paralysis (52.6%). Less than a quarter recognised having problems eating (24.7%), difficulties swallowing (23.3%), one-sided blindness (21.3%), runny eyes (14.4%), sudden confusion (11.5%) or experiencing a prickly feeling (9.9%). A small percentage incorrectly thought that earache was a symptom of stroke (6.5%). On average, participants recognised 5.2 (SE=0.05) out of 14 symptoms.

Table 1 presents the mean number of stroke symptoms recognised by different groups of participants. Women recognised a greater number of symptoms compared with men. Symptom recognition increased with education, but was lowest in the oldest age group. Participants who had personally or knew a family member/friend who had suffered a cardiovascular event recognised more stroke symptoms than those who did not. However, symptom recognition was similar for participants who reported having high blood pressure and those who did not. Finally, stroke symptom recognition increased with numeracy.

Table 2 shows results from a linear mixed-effects analysis accounting for province-level differences in disease burden. In general, greater stroke symptom recognition was found in females, highly educated (vs low education), participants who had a personal or family/friend

with a history of CVD, and those with higher numeracy scores. Additionally, we explored how symptom recognition rates differed across the four economic regions, and found that participants in the Eastern region on average recognised almost two more symptoms than those in the Northeastern region (figure 3). Furthermore, there was a negative correlation between DALYs and symptom recognition rate across economic regions; that is, participants in regions with greater disease burdens tended to recognise fewer symptoms.

Stroke treatment-seeking behaviour

Figure 2 shows that the majority of participants (75.9%) reported that they would call an ambulance, the most appropriate course of action, if they saw a person suffering from stroke symptoms (ie, impaired vision, speech problems, numbness or one-sided debility). However, the second most common course of action was to advise the person to see a doctor (58.8%) rather than to consult a doctor immediately (34.1%). Around 1/3 would recommend bedrest and 1/10 would suggest sipping fluid.

Participants who recognised more stroke symptoms would take each action more frequently, suggesting a positive relation between symptom recognition and action. With regard to calling an ambulance, we found that with each additional symptom recognised, the probability of calling an ambulance increased by two percentage points. Moreover, participants who personally had or knew a family member/friend who had suffered a

Table 1 Average number of stroke and heart attack symptoms recognised by sociodemographic categories

Sociodemographics	Stroke		Heart attack	
	Mean	95% CI	Mean	95% CI
Sex				
Male	4.82	4.67 to 4.96	2.51	2.45 to 2.56
Female	5.52	5.37 to 5.66	2.66	2.61 to 2.71
Age category				
18–29	5.20	5.01 to 5.39	2.63	2.56 to 2.70
30–49	5.23	5.06 to 5.37	2.60	2.54 to 2.66
50–69	5.01	4.82 to 5.20	2.50	2.42 to 2.58
Education*				
Low	4.88	4.69 to 5.07	2.48	2.40 to 2.55
Medium	5.12	4.93 to 5.30	2.59	2.52 to 2.66
High	5.40	5.24 to 5.56	2.65	2.59 to 2.71
High blood pressure				
Yes	4.91	4.63 to 5.19	2.47	2.35 to 2.59
No	5.19	5.08 to 5.29	2.59	2.55 to 2.63
Personal or family/friend CVD history				
Yes	5.45	5.30 to 5.59	2.69	2.63 to 2.74
No	4.81	4.67 to 4.96	2.46	2.40 to 2.51
Numeracy score				
0	4.36	4.16 to 4.56	2.31	2.24 to 2.39
1	5.02	4.84 to 5.19	2.52	2.45 to 2.59
2	5.33	5.15 to 5.52	2.70	2.63 to 2.77
3	6.18	5.91 to 6.45	2.87	2.77 to 2.96

Results are weighted by age and sex for each economic region.

*International Standard Classification of Education.

CVD, cardiovascular disease.

cardiovascular event were slightly more likely to state that they would call an ambulance (77.3%) than those without such history (74.2%), so did participants with a personal history of high blood pressure (81.7%) compared with those without such history (75.2%).

Heart attack symptom recognition

As shown in [figure 1](#), the majority of participants correctly recognised chest pain (83.0%), shortage of breath (70.5%), and nausea (55.2%) as heart attack symptoms. Almost one-third incorrectly identified headache as a symptom (29.8%), higher than the percentages of participants who correctly recognised anxiety (26.3%), arm pain (14.4%) and stomach pain (8.6%). On average, participants recognised 2.6 (SE=0.02) out of 6 symptoms.

Recognition rates for heart attack and stroke symptoms were highly correlated ($r=0.59$), and similar characteristics were associated with heart attack symptom recognition as with stroke symptom recognition ([tables 1 and 2](#)), with the only difference being that highly educated participants did not recognise more heart attack symptoms than those with lower education levels. Moreover, similar to stroke, participants in the Eastern and the Northeastern

regions recognised the greatest and the fewest number of symptoms, respectively, and there was a negative relationship between average DALYs and heart attack symptom recognition rates across regions ([figure 3](#)).

DISCUSSION

To our knowledge, this is the first population-based survey on stroke and heart attack symptom recognition and stroke actions in a representative sample of the Chinese public. In general, symptom knowledge was moderate—around 5 out of 14 stroke symptoms and 3 out of 6 heart attack symptoms were recognised by more than 50% of participants. Whereas the majority of participants would call an ambulance when seeing a person suffering from stroke symptoms, around one-quarter would not take immediate action and the second most common course of action was to advise seeing a doctor rather than to consult a doctor immediately.

Relative to other population-based studies ([online supplemental tables S8 and S9](#)), symptom recognition rates were higher than those reported in representative

Table 2 Results of mixed-effect models on stroke and heart attack symptom recognition

	Stroke symptoms		Heart attack symptoms	
	Estimate (SE)	95% CI*	Estimate (SE)	95% CI*
Intercept	3.65 (0.44)	2.80 to 4.48	2.20 (0.12)	1.97 to 2.43
Province-level DALYs†	-0.55 (0.38)	-1.30 to 0.21	-0.10 (0.09)	-0.29 to 0.08
Sex				
Male	Ref		Ref	
Female	0.65 (0.09)‡	0.49 to 0.83	0.14 (0.04)	0.07 to 0.21
Age category				
18–29	Ref		Ref	
30–49	0.15 (0.11)	-0.05 to 0.40	-0.00 (0.04)	-0.09 to 0.08
50–69	0.18 (0.14)	-0.08 to 0.45	-0.04 (0.06)	-0.15 to 0.08
Education§				
Low	Ref		Ref	
Medium	0.17 (0.12)	-0.06 to 0.40	0.06 (0.05)	-0.03 to 0.15
High	0.54 (0.13)	0.30 to 0.78	0.10 (0.05)	-0.01 to 0.20
High blood pressure				
No	Ref		Ref	
Yes	-0.07 (0.15)	-0.37 to 0.23	-0.10 (0.06)	-0.22 to 0.02
Personal or family/friend CVD history				
No	Ref		Ref	
Yes	0.40 (0.09)	0.23 to 0.58	0.18 (0.04)	0.11 to 0.25
Numeracy score	0.45 (0.05)	0.36 to 0.54	0.15 (0.02)	0.11 to 0.19
	Intercept $\sigma^2=2.58$, SD=1.61		Intercept $\sigma^2=0.14$, SD=0.33	

*Bootstrapped CIs.

†DALYs were rescaled with one unit representing one SD.

‡Male is the reference group (ref) for the predictor 'sex'. The interpretation of the coefficient is that relative to males, the model estimates that females recognised 0.65 more stroke symptoms with the SE at 0.09.

§International Standard Classification of Education.

CVD, cardiovascular disease; DALYs, disability-adjusted life years.

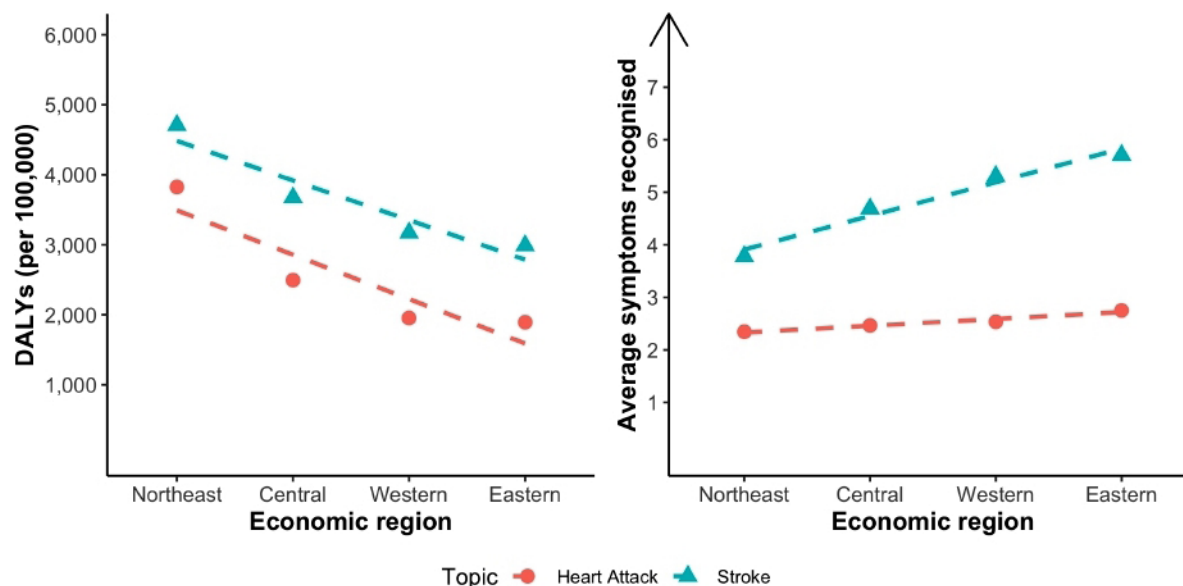


Figure 3 Disability-adjusted life years (DALYs) and the average numbers of stroke and heart attack symptoms recognised by participants of each economic region. Dashed lines represent linear regression lines.

European samples¹⁵ and around the same levels as those in Germany, the best among the nine European countries. However, they are lower than those in Singapore²² and South Korea.²³ Heart attack recognition rate was similar to a recent study of older Hong Kong adults,⁸ yet similar deficits in the breadth of symptom knowledge were found: although chest pain was recognised by the majority of participants, recognition of other symptoms was relatively poor. Increasing awareness of multiple heart attack symptoms or patterns is important, because not all heart attack patients demonstrate all symptoms and women in particular often experience 'atypical' symptoms that may delay immediate action.^{24 25}

Consistent with prior studies, females and individuals with a personal or family/friend history of cardiovascular events recognised a greater number of symptoms.^{8 15 22 23} Efforts to reduce the gender gap could target differences in health information seeking behaviour between men and women,²⁶ particularly given that the burden of CVDs is higher in men.¹ Contrary to prior studies, age was not associated with greater symptom recognition, and education was associated only with recognition of stroke symptoms^{15 22 23}; rather, individuals with higher numeracy scores consistently recognised more symptoms. Unlike education levels, numeracy scores differed substantially across economic regions (eg, $M=1.64$ for Eastern and $M=0.92$ for Northeastern), and the two variables were only moderately correlated ($r=0.18$). Boosting numerical competencies by, for instance, using more transparent statistical or visual formats to represent health statistics in communications may promote broader and better health literacy.²⁷ These strategies may be particularly helpful in the Northeastern region, where the CVD burden is the highest per capita while symptom knowledge and numeracy levels are the lowest among the four economic regions.

A personal history of high blood pressure did not increase symptom recognition, although it was associated with a slight increase in the intention to call an ambulance when seeing others suffering from stroke symptoms. In contrast, while participants who had or knew a family member/friend who had suffered a cardiovascular event recognised more stroke and heart attack symptoms, they were only marginally more likely to take immediate action and call an ambulance. These results emphasise an important gap between taking action and being able to recognise potential symptoms in the first place. Indeed, around 25% of participants who recognised at least one of the stroke symptoms in the stroke action scenario did not indicate that they would call an ambulance.

A strategy to strengthen the association between symptom recognition and action would be to simplify detection, especially for stroke, which is associated with many potential symptoms and imposes a bigger challenge for recognition. Tools such as the Cincinnati Prehospital Stroke Scale and the Face Arm Speech Time (FAST) tests can be helpful in this regard. These tests rely on a few simple rules to detect stroke, with FAST emphasising

the importance of timing between symptom onset and action, and both tests are found to have similar sensitivities and specificities to those of more complex tests.²⁸ In the present study, over 92% of participants recognised at least one of the three symptoms mentioned in the FAST test. Among participants who recognised none of the three symptoms, only 66% indicated that they would call an ambulance in the presence of the specified stroke symptoms, compared with 70% who recognised at least one, 75% who recognised at least two, and 82% who recognised all three symptoms. These results show that educating the public with the FAST test should help invoke the most appropriate action for stroke.

The FAST test is widely promoted on health organisation websites in other countries, including the Center for Disease Control (USA) and the National Health Service (UK), yet it was rarely mentioned in information materials on Chinese websites (see online supplemental material). Public health campaigns that focus on promoting simple detection tools may increase the reach of these campaigns, particularly for individuals with lower levels of numeracy, who tended to recognise fewer stroke and heart attack symptoms and were less knowledgeable about what actions to take. Examples of simple heart attack detection and reaction rules can be found in the Rapid Early Action for Coronary Treatment intervention study.²⁹

One limitation of our study is that even though a representative sampling strategy was undertaken to sample individuals from different economic regions, gender and age groups in China, there was a likely under-representation of rural communities in our sample. It is possible that individuals from rural areas have poorer knowledge than those from larger urban areas.¹² We also sought a representative sample of the Chinese population aged between 18 and 69 years old, meaning that our sample did not focus on older age groups for whom stroke and heart attack risks are higher, and being able to recognise symptoms and taking appropriate action are extremely important.^{8 13} Further, while we explored treatment seeking behaviour in response to stroke symptoms, we did not examine behaviour in response to heart attack symptoms in the present study. Owing to time and cost restraints of the study, we focused on responses to stroke symptoms, because stroke is the number one cause of death in China, immediate action is a precursor to effective treatments, and it would offer a direct comparison to a large representative study of nine European countries.¹⁵ Future studies could explore actions in response to heart attack symptom recognition, particularly as recent research suggests that the primary response of older adults in China to heart attack symptom scenarios is to seek non-emergency medical care.⁸

CONCLUSION

The results of the present study can serve as references against which the efficacy of future interventions to improve symptom recognition of stroke and heart attack

in the Chinese public may be evaluated. Although recognition rates for some symptoms were higher than those reported in prior studies, further educational efforts are needed to address less common symptoms for stroke and heart attack and to promote more immediate treatment-seeking actions based on a few recognisable symptoms for stroke.

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Contributors MM and SL contributed to the conceptualisation of the project, development of methods, interpretation of results and manuscript writing. SL oversaw data collection and management. MM was responsible for data analysis. YY and YH translated testing materials from English to Chinese and data files from Chinese to English. YY collected auxiliary data. All authors read and approved the final manuscript.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study was approved by the Ethics Committee of the Institute of Psychology, Chinese Academy of Sciences (approval number 2018-0192).

Provenance and peer review Not commissioned; externally peer reviewed.

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