

Is the Population Detected by Screening in China Truly at High Risk of Stroke?

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Aim: The Chinese Stroke Screening and Prevention Project (CSSPP) considers patients with 3 or more risk factors to be at high risk of stroke, and does not quantitatively assess the risk for stroke. However, to detect high-risk groups more efficiently, a health risk appraisal (HRA) model should be used to assess individual risk of stroke. *Methods:* The odds ratios for the 8 risk factors for stroke were pooled and the data were used to develop an HRA model to predict individuals' risks of developing stroke in the next 5 years. The Chinese screening project and HRA screening strategies were then compared. *Results:* We assessed 4196 Chinese individuals who received checkups in 2015. The average 5-year risk of stroke was 5.81%, with men being at higher risk of stroke than women over that period. The average 5-year risk of stroke also increased with the number of risk factors. 932 individuals (22.2%) were identified as being at high risk of stroke according to CSSPP, whereas 318 individuals with fewer than 3 risk factors were considered being at low risk despite having a 5-year risk of stroke greater than 4.0% by our assessment. Notably, among patients with hypertension and diabetes who were classified as being at low risk of stroke by the CSSPP, the HRA recognized 15.9% and 14.3% as being at high risk of stroke, respectively. *Conclusion:* All 8 major risk factors affect stroke risk differently, and the efficiency of clustering these risk factors might be improved by considering the relative risk of each factor with an HRA model. **Key Words:** Stroke—risk assessment—screening—risk factors—Chinese.

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Introduction

Cerebrovascular disease has become one of the leading causes of death worldwide. The age-standardized incidence of stroke decreased significantly by 12% in high-income countries, and albeit nonsignificantly, increased by 12% in low- and middle-income countries between 1990 and 2010.¹ In China, stroke has been the leading cause of death since 2012, and its incidence has been increasing at a rate of 8.7% per year.² Stroke places a huge burden on society in terms of death, disability, and cost of health care.³⁻⁵ Previous research has shown that several interventions are effective in both the primary and secondary prevention of stroke, and it is estimated that effective implementation of these interventions could reduce the incidence of stroke.⁶⁻⁸ Therefore, we must identify those individuals at high risk of stroke if we are to target interventions appropriately.

The Chinese government has put a great deal of effort in providing better stroke prevention services. To this end, it officially launched the Chinese Stroke Screening and Prevention Project (CSSPP) in 2009. The CSSPP assesses the 8 major risk factors for stroke: hypertension, diabetes mellitus, hyperlipidemia, heart disease or atrial fibrillation (AF), obesity, smoking, physical exercise, and family history of stroke. Individuals with at least 3 risk factors are considered at high risk of stroke. Although the scale of the CSSPP has undergone continued growth, little attention has been paid to its effectiveness as a screening strategy. In addition, an individual's risk of stroke is not assessed quantitatively by the CSSPP, and this could influence the screening results. Therefore, we aimed to explore whether the population detected during screening was truly at high risk of stroke.

To assess the efficiency of detecting high-risk groups, we performed a health risk appraisal (HRA) to assess individuals' risks of stroke, and then compared the results with those based on the CSSPP to identify high-risk individuals who we either correctly detected or incorrectly missed. We expected the pooled results to improve the efficiency of the CSSPP.

Methods

HRA Model

An HRA model was developed based on the results of a meta-analysis of the main risk factors for stroke.⁹ The risk factors were estimated using the risk score conversion tables. The combined risk score (CRS) was calculated as the sum of scores of the included risk factors. The absolute risk of stroke in the next 5 years was estimated using the CRS and 5-year incidence probability table.

Calculation of the Pooled Odds Ratios by Meta-Analysis

In our previous meta-analysis, we reported the main risk factors for stroke in Chinese people.⁹ In that analysis, we included 178 case-control articles in a systematic review, among which 141 articles concerned hypertension, 147 concerned smoking, 11 concerned physical exercise, 21 concerned overweight and obesity, 64 concerned hyperlipidemia, 144 concerned diabetes mellitus, 54 concerned heart disease, and 40 concerned family history of stroke. The odds ratios were then pooled using Review Manager 5.3 (The Cochrane Collaboration, Copenhagen, The Nordic Cochrane Centre, Denmark), and the results for the 8 risk factors are shown in Table 1.

The Proportions of Risk Factors' Exposure

The proportions of the general population exposed to risk factors of stroke were obtained from the China Health and Nutrition Survey (2012), and from major reports on chronic disease risk factor surveillance in China (Table 2).¹⁰⁻¹⁶

Table 1. Pooled odds ratios of the main risk factors for stroke among Chinese people

Risk factors	OR	95% CI
Smoking (yes)	1.84	1.72-1.98
Physical inactivity (yes)	2.04	1.19-3.47
Overweight (yes)	2.01	1.65-2.47
History of hypertension (yes)	3.50	3.18-3.85
History of hyperlipidemia (yes)	1.82	1.58-2.09
History of diabetes mellitus (yes)	2.51	2.31-2.73
History of heart disease (yes)	2.19	1.83-2.61
Family history of stroke (yes)	2.68	2.28-3.14

Abbreviations: CI, confidence interval; OR, odds ratio.

Risk Score Calculation

The risk factors for stroke were estimated using the risk score conversion table (Table 3, providing quantitative criteria for assessment) and Equation 1. A risk score of more than 1.00 was taken to indicate an increased risk of stroke. The baseline incidence ratio was calculated based on the following:

$$RS_i = POR_i \times BIR = \frac{POR_i}{\sum_{i=1}^n POR_i \times P_i} \quad (\text{Equation 1})$$

RS_i : Risk score of exposure factor i

POR_i : Pooled odds ratio

BIR : Baseline incidence ratio

P_i : Proportion of risk factors' exposure

Calculation of Combined Risk Score

The CRS was calculated as the total of all risk scores for an individual at risk of stroke. We used the "credit-debit" method to combine the risk factor scores into a composite risk factor.¹⁷ The RS_i values exceeding 1.0 had 1.0 subtracted to them and the resulting values were added together (Equation 2), whereas the RS_i values less than 1.0 were multiplied together (Equation 3). The sum of these products then yielded the CRS (Equation 4).

Table 2. The proportions and risk factors' exposure in Chinese people

Risk factors (x_i)	Proportions (%)
Smoking	25.10
Overweight	30.60
Physical exercise	11.90
History of hypertension	29.60
History of hyperlipidemia	18.60
History of diabetes mellitus	11.60
History of heart disease	20.00
Family history of stroke	1.68

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