Impact of regional differences in stroke symptom awareness and low-income status on seeking emergency medical service in China

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Abstract

Background: Unawareness of stroke symptoms and low income are two barriers that affect the seeking of emergency medical service (EMS). This study aimed to assess the effect of unawareness and low income on seeking EMS and to investigate the regional distribution of the unawareness and low-income status and their associations with failing to call EMS in China.

Methods: A total of 187,723 samples from the China National Stroke Screening Survey was interviewed cross-sectionally. Four status of awareness and annual income were identified: unaware and low-income, unaware-only, low-income-only, and aware and regular income. The outcomes were whether they intended to call EMS or not. The regional distribution of each status and their associations with not calling EMS were presented.

Results: The status of unaware and low-income, unaware-only, and low-income-only accounted for 6.3% (11,806/187,673), 11.9% (22,241/187,673), and 21.5% (40,289/187,673) of the total sample, respectively. Not calling EMS was significantly associated with the status of unaware and low-income (odds ratio [OR]: 3.21, 95% confidence interval [CI]: 3.07–3.35), unaware-only (OR: 2.38, 95% CI: 2.31–2.46), and low-income-only (OR: 1.67, 95% CI: 1.63–1.71), compared with the aware and regular income status. The Midwest regions had higher percentages of people in the unaware and low-income status; the East, South, and Central had higher percentages of unaware-only status; the North and Northeast regions had a higher percentage of low-income-only status, compared with other regions.

Conclusion: The existence of the regional difference in unawareness and low income justifies the specific stroke education strategies for the targeted regions and population.

Keywords: Stroke; Cerebrovascular disease; Awareness; Income; Emergency medical service; Developing countries

Introduction

China has one of the highest incidences of stroke worldwide.[1] The China National Stroke Screening Survey (CNSSS) was established in 2013 as a large-scale community-based stroke surveillance program among residents of all 31 provinces in China.[2,3] In our previous report from CNSSS,[4] the stroke prevalence in 2014 was 2.06% in adults aged 40 years and older in China. Notably, stroke incidence in adults aged 40 to 74 years increased by 8.3% annually from 2002 to 2013. As a populous country, it is urgent to lower stroke-related morbidity and mortality to alleviate China's social and economic burden.

Reperfusion therapy plays a pivotal role, which requires the seeking of emergency medical service (EMS) promptly.[5,6] Pre-hospital recognition and transport are crucial initial steps for in-hospital acute stroke care.[7] However, pre-hospital delays have been a major obstacle for reperfusion therapy in China.[8,9] Although the educational program "Stroke 120" has been launched since 2016 to improve public awareness and has witnessed good effect,[10,11] the rates of unawareness and not calling EMS were 18.1% and 39.1% as reported in our previous paper, indicating that stroke awareness does not necessarily translate into appropriate actions.[12] Among the multiple factors that affect the seeking of EMS, unawareness and low income are two significant barriers.[12] More

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importantly, China is a huge country with a multi-ethnic population, diversified culture, and economic imbalance in different regions. Although China has seen a dramatic decline in poverty,[13,14] according to the report of the National Bureau of Statistics, there were still 5.51 million people in 2019 whose annual income was below the current poverty standard in rural areas.[14,15] It is of practical significance to locate the geographical distribution of the groups of people who were unaware and low-income, unaware-only, or low-income-only, to provide appropriate countermeasures, and to alleviate the poverty-related illness to the targeted regions and population. Therefore, this paper aims to assess the effect of unawareness and low-income on seeking EMS and to investigate the regional distribution of the unawareness and low-income status and their associations with failing to call EMS in China.

Methods

Ethical approval

This study was approved by the Peking Union Medical College Hospital Institutional Review Board (No. S-K194). Written informed consent was obtained from all participants.

Study design and participants

The FAST-RIGHT study is a cross-sectional branch survey of the CNSSS (details in previous publications).[12,16,17] Briefly, in the CNSSS, residents aged 40 years and over were sampled from 221 counties in China using a two-stage stratified sampling framework. Among the 221 counties, a sub-sample of residents ($n = 187,723$) who were interviewed in-person between January 1 and May 31, 2017, from 69 counties covering most provinces constituted the FAST-RIGHT study (see the online-only Data Supplement by Li *et al*[12]). Participants were excluded for missing annual income data ($n = 50$).

Data collection and assessment of awareness status, annual income, intention to call EMS, and covariates

Participants were interviewed face-to-face by trained staff using standard questionnaires designed by the study team.[12] The exposure of interest is the status of awareness and income, which was categorized into four status: unaware and low-income (below RMB 5000 Yuan, approximately $714 annually as low-income), unaware-only (unaware and regular income), low-income-only (aware and low-income), and aware and regular income. For assessing awareness, participants were asked whether they knew the possible cause of the symptoms of sudden facial droop, arm weakness, or speech disturbance. The outcome of interest is the intention of calling EMS (yes or no). Participants were asked how they would act if they had suspected stroke symptoms mentioned above from the three choices of home observing, waiting for family members to go to a hospital, or calling an ambulance immediately. The final option was regarded as the correct action and defined as having the intention of calling EMS in the present analysis. Other covariates of demographics, socioeconomic, and vascular risk factors were collected in the survey.[12,16] In the analysis for regional difference, the participating 69 administrative counties were classified into six regions of North and Northeast, East, Central, South, Southwest, and Northwest.

Statistical analysis

Characteristics distribution of the total sample, two groups by intention to call (or not) EMS, and the sub-sample of each region were presented as counts and percentages, with Chi-square tests for group comparison. Multivariate logistic regression was performed to examine the association between the binary dependent variable of intention to call EMS (the probability of not calling EMS was modeled) and the independent variable of the status of awareness and income (aware and regular income as reference) in the total sample. The covariates were selected based on findings from our previous analysis[12] and clinically significant judgment. The covariates were age, sex, education, urban or rural residency, insurance type, residential region, the yes-or-no questions of living with family, stroke occurrence in family members or friends, presence of vascular risk factors (defined as having one of the following conditions, including hypertension, diabetes, hyperlipidemia, heart disease, smoking, or drinking alcohol). The interaction term of age group × region was tested significant ($P < 0.0001$) and was kept in the model. Then, the multivariate logistic regression model was performed in each region. Finally, the accounted percentages of the four status of awareness and income, and their associated percentages of not calling EMS in each region were calculated. Considering the potential urban and rural sampling bias effect, the percentages were standardized according to the 2010 population census of China[18] by using the direct standardization method. For example, the standardized percentage of unaware and low-income in the Northwest region was calculated by multiplying their percentages in urban or rural with the corresponding population in the Northwest in the 2010 Census. The sum of products in urban and rural areas was divided by the Northwest's total population in the 2010 Census to calculate the standardized percentages. The same methods were applied to calculate the standardized percentages of each status in each region, and of not calling EMS. Sensitivity analysis was performed in the sub-group ($n = 183,420$) excluded participants who had a stroke history ($n = 4254$). P value was set to <0.05, and SAS version 9.3 (SAS Inc., Cary, NC, USA) was used for analysis.

Results

The average age of the 187,673 participants was 60.8 ± 11.7 years, of which 45.4% (85,240/187,673) were males. The status of unaware and low-income, unaware-only, and low-income-only accounted for 6.3% (11,806/187,673), 11.9% (22,241/187,673), and 21.5% (40,289/187,673) of the total sample, respectively. The distribution of the characteristics was significantly different between the groups by intention to call EMS [Table 1] and in different regions (P value not shown, all $P < 0.0001$) [Table 2].

Table 1: Characteristics of patients with stroke symptoms in two groups, *n* (%).

Items	Total sample (*n* = 187,673)	Not call EMS (*n* = 73,302)	Call EMS (*n* = 114,371)	*P*
Awareness and income status				<0.0001
Unaware and low-income	11,806 (6.3)	7883 (66.8)	3923 (33.2)	
Unaware-only	22,241 (11.9)	11,769 (52.9)	10,472 (47.1)	
Low-income-only	40,289 (21.5)	19,380 (48.1)	20,909 (51.9)	
Aware and regular income	113,337 (60.4)	34,270 (30.2)	79,067 (69.8)	
Age				<0.0001
<65 years	117,243 (62.5)	45,156 (38.5)	72,087 (61.5)	
≥65 years	70,340 (37.5)	28,146 (40.0)	42,284 (60.0)	
Sex				0.0023
Male	85,240 (45.4)	33,614 (39.4)	51,626 (60.6)	
Female	102,433 (54.6)	39,688 (38.8)	62,745 (61.3)	
Education				<0.0001
University	11,063 (5.9)	2917 (26.4)	8146 (73.6)	
Middle/high school	90,696 (48.3)	29,649 (32.7)	61,047 (67.3)	
Primary school	85,914 (45.8)	40,736 (47.4)	45,178 (52.6)	
Site				<0.0001
Urban	91,422 (48.7)	27,044 (29.6)	64,378 (70.4)	
Rural	96,251 (51.3)	46,258 (48.1)	49,993 (51.9)	
Living status				<0.0001
With family	180,741 (96.6)	70,903 (39.2)	109,838 (60.8)	
Alone or with others	6402 (3.4)	2279 (35.6)	4123 (64.4)	
Medical insurance				<0.0001
Urban	93,852 (50.5)	27,958 (29.8)	65,894 (70.2)	
Rural	92,183 (49.5)	44,788 (48.6)	47,395 (51.4)	
Stroke in acquaintance				<0.0001
Yes	37,577 (20.0)	12,842 (34.2)	24,735 (65.8)	
No	150,096 (80.0)	60,460 (40.3)	89,636 (59.7)	
Vascular risk factors present				<0.0001
Yes	60,093 (32.0)	21,860 (36.4)	38,233 (63.2)	
No	127,580 (68.0)	51,442 (40.3)	76,138 (59.7)	
Regions				<0.0001
North + Northeast	11,801 (6.3)	3878 (32.9)	7923 (67.1)	
East	55,827 (29.8)	21,705 (38.9)	34,122 (61.1)	
Central	59,804 (31.9)	22,042 (36.9)	37,762 (63.1)	
South	22,533 (12.0)	10,179 (45.2)	12,354 (54.8)	
Southwest	20,589 (11.0)	6355 (30.9)	14,234 (69.1)	
Northwest	17,119 (9.1)	9143 (53.4)	7976 (46.6)	

Vascular risk factors present were defined as having one of the following conditions, including hypertension, diabetes, hyperlipidemia, heart disease, smoking, or drinking alcohol. EMS: Emergency medical service.

In the total sample [Figure 1], after adjusting for the covariates, the effect of associations with not calling EMS was in a hierarchical order: unaware and low-income status (odds ratio [OR] = 3.21, 95% confidence interval [CI]: 3.07–3.35, $P < 0.0001$), the unaware-only status (OR = 2.38, 95% CI: 2.31–2.46, $P < 0.0001$), and low-income-only status (OR = 1.67, 95% CI: 1.63–1.71, $P < 0.0001$), compared with the aware and regular income status. Sensitivity analysis conducted among participants without a stroke history did not substantially change the findings.

As illustrated in Figure 2, the unaware and low-income status consistently showed the most prominent and robust association with not calling EMS in the five regions, except the Central. Notably, in the Northwest, the unaware and low-income status had 13.04 (95% CI: 11.00–15.54, $P < 0.0001$) times of risk than the aware and regular income status. Besides the unaware and low-income status, the unaware-only status was significantly associated with not calling EMS in the East (OR = 4.14, 95% CI: 3.91–4.39, $P < 0.0001$). Low-income-only status showed moderate effects in the regions except for the Northwest.

We also found that the interaction effect existed between age groups and regions ($P < 0.0001$ for interaction). In the total sample [Figure 1], participants aged 65 years and over were less likely to call EMS than those below the age of 65 years (OR = 1.52, 95% CI: 1.43–1.62). However, the associations of age groups with calling EMS varied in different regions [Figure 2]. Participants aged 65 years and over were less likely to call EMS in the North and Northeast (OR = 1.16, 95% CI: 1.04–1.29), Southwest (OR = 1.38, 95% CI: 1.29–1.49), and Northwest

Table 2: Characteristics of the patients with stroke symptoms in each region.

Characteristics	North and Northeast (n = 11,801)	East (n = 55,827)	Central (n = 59,804)	South (n = 22,533)	Southwest (n = 20,589)	Northwest (n = 17,119)
Awareness and income status						
Unaware and low-income	236 (2.0)	1796 (3.2)	3447 (5.8)	2301 (10.2)	1367 (6.6)	2659 (15.5)
Unaware-only	418 (3.5)	7107 (12.7)	7788 (13.0)	3175 (14.1)	2405 (11.7)	1348 (7.9)
Low-income-only	3583 (30.4)	8150 (14.6)	14,519 (24.3)	6500 (28.9)	5148 (25.0)	2389 (14.0)
Aware and regular income	7564 (64.1)	38,774 (69.5)	34,050 (56.9)	10,557 (46.9)	11,669 (56.7)	10,723 (62.6)
Age						
<65 years	8483 (71.9)	36,221 (64.9)	34,685 (58.0)	13,614 (60.4)	12,465 (60.5)	11,775 (68.8)
≥65 years	3318 (28.1)	19,606 (35.1)	25,119 (42.0)	8919 (39.6)	8124 (39.5)	5344 (31.2)
Sex						
Male	5560 (47.1)	25,377 (45.5)	26,942 (45.1)	10,178 (45.2)	9111 (44.3)	8072 (47.2)
Female	6241 (52.9)	30,450 (54.5)	32,862 (54.9)	12,355 (54.8)	11,478 (55.8)	9047 (52.8)
Education						
University	1608 (13.6)	2205 (3.9)	4287 (7.2)	697 (3.1)	866 (4.2)	1400 (8.2)
Middle/high school	6600 (55.9)	25,279 (45.3)	30,050 (50.2)	11,527 (51.2)	9184 (44.6)	8056 (47.1)
Primary school	3593 (30.5)	28,343 (50.8)	25,467 (42.6)	10,309 (45.7)	10,539 (51.2)	7663 (44.8)
Site						
Urban	6215 (52.7)	28,167 (50.5)	27,509 (46.0)	8979 (39.8)	9969 (48.4)	10,583 (61.8)
Rural	5586 (47.3)	27,660 (49.5)	32,295 (54.0)	13,554 (60.2)	10,620 (51.6)	6536 (38.2)
Living status						
With family	11,119 (94.3)	53,462 (96.3)	57,976 (97.2)	21,946 (97.5)	19,574 (95.3)	16,664 (97.5)
Alone or with others	669 (5.7)	2078 (3.7)	1702 (2.8)	559 (2.5)	966 (4.7)	428 (2.5)
Medical insurance						
Urban	8171 (69.6)	27,922 (50.4)	28,224 (47.5)	9747 (44.1)	9948 (48.7)	9840 (58.0)
Rural	3566 (30.4)	27,471 (49.6)	31,188 (52.5)	12,348 (55.9)	10,474 (51.3)	7136 (42.0)
Stroke in acquaintance						
Yes	4773 (40.5)	9744 (17.5)	14,748 (24.7)	3447 (15.3)	1598 (7.8)	3267 (19.1)
No	7028 (59.5)	46,083 (82.5)	45,056 (75.3)	19,086 (84.7)	18,991 (92.2)	13,852 (80.9)
Vascular risk factors present						
Yes	3674 (31.1)	18,155 (32.5)	20,631 (34.5)	6956 (30.9)	6444 (31.3)	4233 (24.7)
No	8127 (68.9)	37,672 (67.5)	39,173 (65.5)	15,577 (69.1)	14,145 (68.7)	12,886 (75.3)

Data are presented as n (%). Vascular risk factors present were defined as having one of the following conditions, including hypertension, diabetes, hyperlipidemia, heart disease, smoking, or drinking alcohol.

(OR = 1.70, 95% CI: 1.57–1.84) regions. Nonetheless, participants aged 65 years and over were more likely to do so in the East (OR = 0.91, 95% CI: 0.87–0.95), Central (OR = 0.87, 95% CI: 0.84–0.90), and South (OR = 0.96, 95% CI: 0.90–1.03) regions.

The standardized percentages of each status of awareness and income, and not calling EMS in each region were shown in Table 3. For unaware and low-income status, the accounted percentage was highest in the Northwest region (a standardized percentage of 23.1%), followed by the South (9.3%), the Southwest (7.7%), the Central (6.0%), and was lower in the East (3.1%) and the North and Northeast (1.9%) regions. There were 50.9% to 72.1% of people in this particular status who failed to call EMS in five regions, except that the rate in central was relatively lower (32.6%). For the unaware-only status, the accounted percentages from high to low were South (15.4%), Central (13.2%), East (12.6%), Southwest (10.9%), Northwest (6.7%), and North and Northeast (3.5%). There were 36.9% to 66.3% of people in this particular status who failed to call EMS. Of note is that the East region ranked the highest (66.3%) in failing to call EMS due to unaware-only. Nearly one-third of people in the low-income-only status in regions of North and Northeast (29.2%), Southwest (28.7%), South (26.6%), and Central (25.0%). There were 35.6% to 58.0% of people in the four regions who failed to call EMS due to low-income-only. Even under the aware and regular status, the Northwest region had 53.2% of people who failed to call EMS.

Discussion

Our study showed that the status of unaware and low-income, unaware-only, and low-income-only were all significantly associated with not calling EMS, especially the first one. Unaware and low-income status was the most influential factor in almost all regions, but higher percentages of people under this status lived in the Midwest part of China, especially in the Northwest. Besides the unaware and low-income, unaware-only was the main barrier of not calling EMS in the East, the South, and the Central, and low-income-only was the prominent barrier of not calling EMS in the North and Northeast.

Higher stroke incidence and higher prevalence of vascular risk factors had been reported in North and West

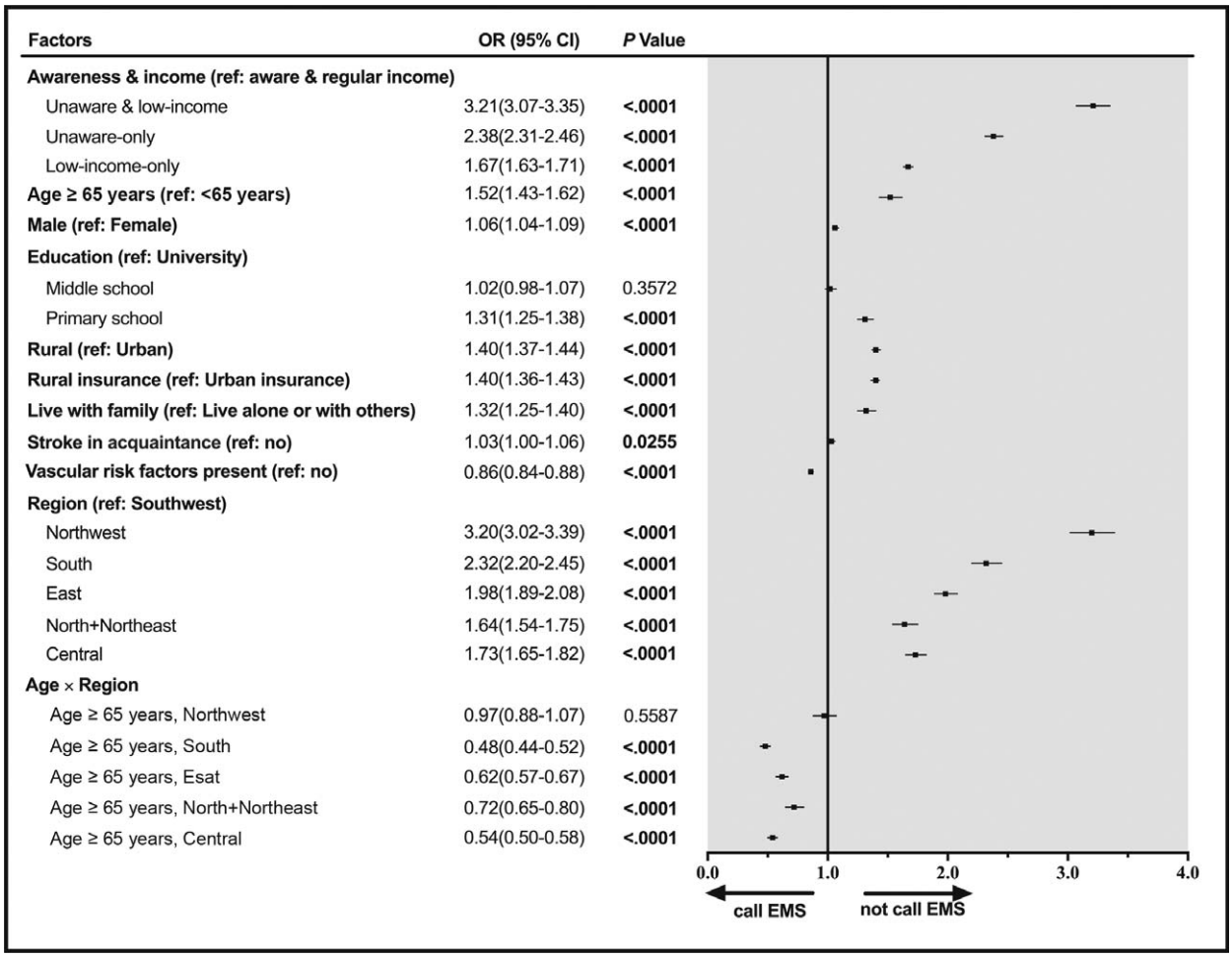

Figure 1: Associations between awareness and income status of patients have stroke symptom with not calling EMS. The forest plot and the corresponding statistical results illustrate the associations between awareness and income status with not calling EMS, adjusting for covariates. EMS: Emergency medical service; OR: Odds ratio; CI: Confidence interval.

China,[19,20] where they largely overlap with the regions that had higher percentages of participants in the high-risk status of unaware and low-income (Northwest, Southwest) and low-income only (North and Northeast) in our analysis. Despite the higher stroke prevalence and incidence in West China, the unawareness is still higher than in other regions. Making matters worse, unawareness and low-income in this region doubly threatened the correct action of calling EMS. Low socioeconomic status has been associated with inadequate vascular risk factor control and worse short-term and long-term outcomes after stroke.[21,22] This can create a vicious cycle. Although all people in risk status need to be concerned, priorities need to be given to the population and regions with higher risk by strengthening stroke education and reallocating resources. While participants in North and Northeast showed relatively good awareness, particular efforts should be paid to the targeted low-income people. It is of particular importance to avoid poverty-related illness among the low-income population. The unawareness-only was more prominent than the financial issue in the East, South, and Central, where have better economic development in China.[19,20] Therefore, the top priority in these regions should be improving awareness, with modest financial support only to the low-income population.

Another interesting finding is that older people (age ≥65 years) were more likely to call EMS in the Central, East, and South regions, but less likely to do so in the North and Northeast, Northwest, and Southwest. The underlying reasons for this inconsistency could be complicated. Older age increases the risk of stroke. Besides the factors discussed in this paper, their intention to call EMS could be affected by health literacy and expectation, financial concerns, and availability and utility of health resources, which are related to regional culture and socio-economic development.

Our study's strengths are the representativeness of the sample to the general population (China's national stroke survey with the largest sample size and coverage to date), and the carefully designed sampling and research methods.[16,17] Nevertheless, several potential limitations need to be considered. First, the seeking of EMS was based on the participant's intention but not actual action; therefore, it may not reflect their real-world options. Second, the income data were collected by self-report instead of official statistical data. Third, not calling EMS may be partly affected by the availability of such service in their areas. Our study lacks these data to adjust the analysis. As an essential indicator of EMS availability, the pre-hospital

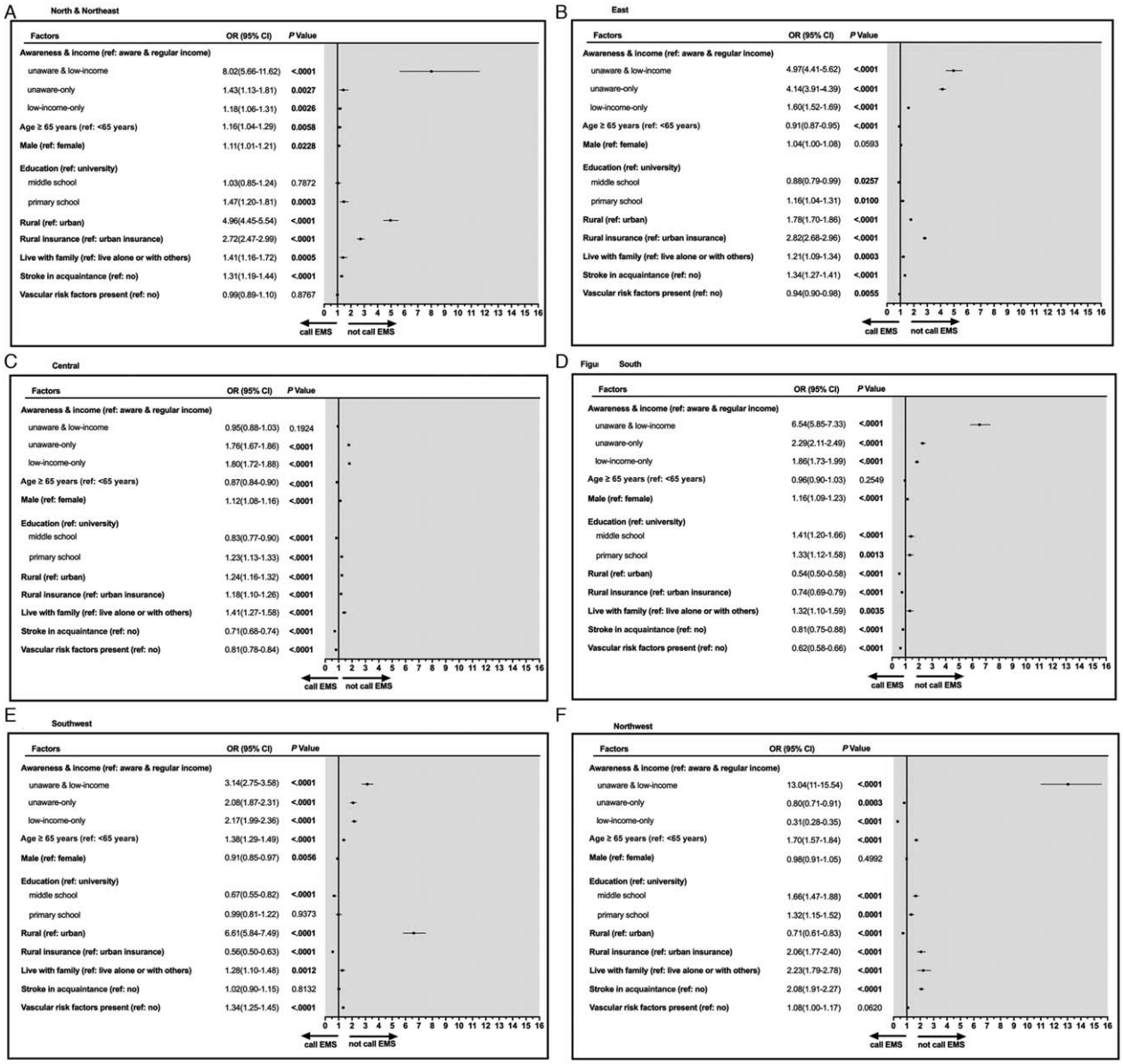

Figure 2: (A–F) Associations between awareness and income status of patients have stroke symptom with not calling EMS in each region. The forest plot and the corresponding statistical results illustrate the associations between awareness and income status with not calling EMS in each region, adjusting for covariates. EMS: Emergency medical service; OR: Odds ratio; CI: Confidence interval.

Table 3: Standardized percentages of each status of awareness, income, and not calling EMS in each region.

Items	North and Northeast		East		Central		South		Southwest		Northwest	
	Status (%)	Not EMS (%)	Status (%)	Not EMS (%)	Status (%)	Not EMS (%)	Status (%)	Not EMS (%)	Status (%)	Not EMS (%)	Status (%)	Not EMS (%)
Unaware and low-income	1.9	60.7	3.1	72.1	6.0	32.6	9.3	65.2	7.7	50.9	23.1	69.1
Unaware-only	3.5	36.9	12.6	66.3	13.2	46.7	15.4	57.1	10.9	45.3	6.7	64.1
Low-income-only	29.2	38.1	14.0	43.2	25.0	43.9	26.6	58.0	28.7	35.6	18.0	34.1
Aware and regular income	65.4	29.6	70.3	29.5	55.9	30.3	48.8	37.0	52.7	22.9	52.2	53.2

EMS: Emergency medical service.

response time could be affected by the EMS service radius, the traffic conditions, and ambulance staff's professionality. A meta-analysis covering 188 urban cities in China reported no significant difference in pre-hospital response time among East, Central, and West after the year 2006.[23] But they did not report situations in rural areas.

To conclude, the risk effects of not seeking EMS (from high to low) were unaware and low-income, unaware-only, and low-income-only, compared with the aware and regular income status. The existence of the regional difference in unawareness and low income justifies specific stroke education strategies for the targeted regions and population.

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Conflicts of interest

None.

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