

Public Awareness of Stroke and Its Predicting Factors in Korea: a National Public Telephone Survey, 2012 and 2014

Gyung-Jae Oh,¹ Jiyoung Moon,²
Yu-Mi Lee,³ Hyeung-Keun Park,⁴
Ki Soo Park,⁵ Yong-Woon Yun,⁶
Gilwon Kang,⁷ Byoung-Gwon Kim,⁸
Jae-Hee Seo,⁹ Heeyoung Lee,¹⁰
Won Kyung Lee,¹¹ Kun Sei Lee,¹²
Hee-Sook Kim,¹³ and Young-Hoon Lee^{1,14}

¹Jeonbuk Regional Cardiocerebrovascular Center, Wonkwang University Hospital, Iksan, Korea; ²Gangwon Regional Cardiocerebrovascular Disease Center, Kangwon National University Hospital, Chuncheon, Korea; ³Daegu-Gyeongbuk Regional Cardiocerebrovascular Disease Center, Kyungpook National University Hospital, Daegu, Korea; ⁴Jeju Regional Cardiocerebrovascular Disease Center, Jeju National University Hospital, Jeju, Korea; ⁵Gyeongnam Regional Cardiocerebrovascular Disease Center, Gyeongsang National University Hospital, Jinju, Korea; ⁶Gwangju-Jeonnam Regional Cardiocerebrovascular Disease Center, Chonnam National University Hospital, Gwangju, Korea; ⁷Chungbuk Regional Cardiocerebrovascular Disease Center, Chungbuk National University Hospital, Cheongju, Korea; ⁸Busan-Ulsan Regional Cardiocerebrovascular Disease Center, Dong-A University Hospital, Busan, Korea; ⁹Daejeon-Chungnam Regional Cardiocerebrovascular Disease Center, Chungnam National University Hospital, Daejeon, Korea; ¹⁰Gyeonggi Regional Cardiocerebrovascular Disease Center, Seoul National University Bundang Hospital, Seongnam, Korea; ¹¹Incheon Regional Cardiocerebrovascular Disease Center, Inha University Hospital, Incheon, Korea; ¹²Department of Preventive Medicine, School of Medicine, Konkuk University, Seoul, Korea; ¹³Division of Chronic Disease Control, Korea Centers for Disease Control and Prevention, Cheongju, Korea; ¹⁴Department of Preventive Medicine & Institute of Wonkwang Medical Science, Wonkwang University School of Medicine, Iksan, Korea

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Address for Correspondence:
Young-Hoon Lee, MD
Department of Preventive Medicine & Institute of Wonkwang Medical Science, Wonkwang University School of Medicine, 460 Iksan-daero, Iksan 54538, Korea
E-mail: lyh8275@hanmail.net

The aim of this study was to investigate time trends in the public awareness of stroke and its predicting factors. The target population was 9,600 community-dwelling adults, aged 19–79 years, in 16 metropolitan cities and provinces in Korea. The survey samples in 2012 and 2014 were selected separately (entirely different sets of subjects) using a proportionate quota sampling method. Information concerning knowledge of stroke and demographics was collected by trained telephone interviewers using random digit dialing. After excluding subjects with a non-response or refusal to answer any question, the analyses included 8,191 subjects in 2012 and 8,127 subjects in 2014. Respondents' awareness of stroke warning signs (numbness or weakness, difficulty speaking or understanding speech, dizziness, visual impairment, and severe headache) was highest for difficulty speaking or understanding speech (80.9% in 2012 and 86.4% in 2014). There were significant increases in the proportion of respondents understanding the appropriate action (i.e., calling an ambulance) at the time of stroke occurrence (59.6% to 67.1%), and in the proportion aware of the general need for prompt treatment (86.7% to 89.8%). In multivariable logistic regression analysis, older age, higher education level, higher household income, current non-smoking, exposure to stroke-related public relations materials, and experience of stroke education were significantly associated with both high knowledge of stroke warning signs and awareness of the need for prompt treatment. Between 2012 and 2014, the public's awareness of stroke increased significantly. More specialized interventions, including public relations materials and education, should focus on subgroups who have lower stroke knowledge.

Keywords: Public; Awareness; Stroke; Warning Signs

INTRODUCTION

Stroke is a significant public health issue in Korea; indeed, stroke is the second leading cause of death after cancer (1). In Korea, recent data have shown a gradual decreasing trend in age-adjusted mortality from diseases of the circulatory system, such as stroke and ischemic heart disease (2,3). However, because of the increase in stroke incidence attributable to the rapid increase in the elderly population in Korea (11.0% in 2010, 15.7% in 2020, and 24.3% in 2030), the socio-economic burden of stroke will increase rapidly (1).

Because prompt treatment affects prognosis and survival after stroke onset (4), public awareness of stroke, including warning signs, appropriate action at the time of occurrence, and the general need for prompt treatment, may be a primary consideration in improving stroke outcomes. Higher knowledge of stroke in patients or bystanders is associated with more rapid access to emergency care (5,6), which may result in improved prognosis and increased survival. Thus, to shorten the time from stroke onset to hospital arrival, improving the public's awareness of stroke warning signs and the need for prompt treatment is important (7).

Previous studies have documented the public awareness of stroke in many countries (8–12). Several studies have also reported public awareness of stroke in Korea; howev-

er, these studies were conducted in limited regions or populations (13-15). Although a recent study reported public awareness in a population-based national survey (16), no identification of temporal changes in public awareness of stroke has been available because only cross-sectional results were available in Korea until now.

Thus, the present study aimed to investigate recent public awareness of stroke and temporal changes in the public's awareness of stroke between 2012 and 2014 (a 2.8-year interval). In addition, we determined the predicting factors for the public's high knowledge of stroke warning signs and awareness of the need for prompt treatment in a nationally representative general public population from 16 metropolitan cities and provinces in Korea.

MATERIALS AND METHODS

Respondents and data collection

The target population comprised adults aged 19-79 years, and the study periods were from 13 January 2012 to 13 February 2012 and from 15 October 2014 to 13 November 2014. The survey was conducted by trained telephone interviewers using random digit dialing. The telephone survey sample was total 9,600 subjects in each year, including 600 individuals from each of 16 metropolitan cities and provinces. The survey samples in 2012 and 2014 were selected separately (different set of subjects) using a proportionate quota sampling method. To minimize selection bias and to include participants without landline telephones, 20% of the total sample was surveyed via mobile phones. Moreover, in consideration of the different usage rates of landline telephones, a time-use survey from Statistics Korea was employed for time-balanced quasi-quota sampling. The confidence interval (CI) and error range were 95% and 4.0%, respectively, for the 600 survey participants. The response rates in 2012 and in 2014 were 18.7% and 16.4%, respectively, for landline telephones and 14.4% and 11.7%, respectively, for mobile phones. Finally, after excluding subjects with a non-response or refusal to answer any question, a total of 8,191 subjects in 2012 (1,409 subjects were excluded) and 8,127 subjects in 2014 (1,473 subjects were excluded) were included in the analyses.

Questionnaire

In 2012 and 2014, using a structured questionnaire, the respondents were asked the following close-ended questions: "If you think the following sentence pertains to symptoms of stroke, please answer 'Yes' or if you do not think so, answer 'No'. If you are unsure, answer 'I do not know.'" Warning signs included the following: sudden numbness or weakness, sudden difficulty speaking or understanding speech, sudden dizziness, sudden visual impairment, and sudden severe headache (14,17). Additionally, to the question, "If someone shows symptoms of stroke,

what do you think you should do first?" the respondents chose one answer among 'take them to a hospital,' 'take them to an Oriental medicine hospital,' 'call an ambulance,' 'contact family,' 'other actions,' or 'do not know.' Finally, to the question, "Do you know there is a need for prompt treatment of stroke, when someone shows warning signs of stroke?" the respondents answered 'yes' or 'no.'

The data also included respondents' socio-demographic characteristics, including gender, age, region (only in 2014 participants), education level, monthly household income, health-related behaviors, diagnosis of stroke in self or immediate family members, diagnosis of stroke in acquaintances, relatives, or neighbors, past medical history of hypertension, diabetes, or dyslipidemia (only in 2014 participants), exposure to public service campaigns and/or advertisements, and experience of stroke education (only in 2014 participants).

Statistical analysis

Differences in the baseline characteristics between the 2012 and 2014 participants were evaluated by χ^2 tests. Differences in awareness of stroke between 2012 and 2014, differences in the proportion of respondents with high knowledge of stroke warning signs ($\geq 4/5$ warning signs), and awareness of the need for prompt treatment according to exposure to stroke-related public relations materials or experience of stroke education in 2014 participants, were also compared using χ^2 tests.

Among 2014 participants, differences in the proportion of respondents' high knowledge of stroke warning signs and awareness of the need for prompt treatment according to socio-demographic characteristics, risk factors, and other covariates were evaluated with χ^2 tests. To identify factors predicting high knowledge of stroke warning signs or awareness of the need for prompt treatment, a multivariable logistic regression analysis was conducted. The odds ratios (OR) and 95% CI were obtained after adjusting for gender, age group, region, education level, monthly household income, smoking status, drinking status, history of stroke in respondent or immediate family, history of stroke in relative, acquaintance, or neighbor, hypertension, diabetes mellitus, dyslipidemia, exposure to stroke-related public relations materials, and experience of stroke education. All statistical analyses were performed using the SPSS for Windows software package (ver. 22.0; SPSS Inc., Chicago, IL, USA). *P* values < 0.05 were considered to indicate statistical significance.

Ethics statement

This study was conducted in accordance with the Declaration of Helsinki guidelines. The study protocol was approved by the Wonkwang University Hospital institutional review board (WK-UH 201410-HRE-068), and informed consent was obtained from each subject.

RESULTS**General characteristics of the respondents**

The respondents' general characteristics are shown in Table 1. The respondents were 8,191 persons (males 50.0%) in 2012 and 8,127 persons (males 50.4%) in 2014 ($P = 0.637$). The age distribution of those 19-39, 40-59, and 60-79 years of age was 37.0%, 42.6%, and 20.4% in 2012 and 37.7%, 41.8%, and 20.5% in 2014

($P = 0.561$). Significant differences in education level, monthly household income, diagnosis of stroke in relatives, acquaintances, or neighbors, and exposure to stroke-related public relations materials were observed between the 2012 and 2014 surveys. The proportion of those exposed to public relations materials increased from 23.0% in 2012 to 29.1% in 2014 ($P < 0.001$). The proportion of those who had experienced stroke education was 7.7% in 2014, while no data was available in 2012.

Table 1. General characteristics of respondents in 2012 and 2014

Characteristics	2012 (n = 8,191)		2014 (n = 8,127)		P value
	No.	(%)	No.	(%)	
Gender					0.637
Male	4,095	(50.0)	4,093	(50.4)	
Female	4,096	(50.0)	4,034	(49.6)	
Age group, yr					0.561
19-39	3,029	(37.0)	3,063	(37.7)	
40-59	3,492	(42.6)	3,401	(41.8)	
60-79	1,670	(20.4)	1,663	(20.5)	
Region					
Rural	-		1,014	(12.5)	
Urban	-		7,113	(87.5)	
Education level, yr					< 0.001
≤ 6	1,073	(13.1)	832	(10.2)	
7-12	2,972	(36.3)	2,831	(34.8)	
≥ 13	4,146	(50.6)	4,464	(54.9)	
Monthly household income, 10,000 won					< 0.001
≤ 200	2,675	(32.7)	2,378	(29.3)	
201-400	3,204	(39.1)	3,220	(39.6)	
≥ 401	2,312	(28.2)	2,529	(31.1)	
Smoking status					
Never smokers	-		5,202	(64.0)	
Former smokers	-		1,451	(17.9)	
Current smokers	-		1,474	(18.1)	
Alcohol drinking status					
Non drinkers	-		2,613	(32.2)	
Light drinkers	-		4,757	(58.5)	
Heavy drinkers	-		757	(9.3)	
Diagnosis of stroke in respondent or immediate family					0.079
No	6,726	(82.1)	6,758	(83.2)	
Yes	1,465	(17.9)	1,369	(16.8)	
Diagnosis of stroke in relative, acquaintance, or neighbor					< 0.001
No	5,775	(70.5)	5,941	(73.1)	
Yes	2,416	(29.5)	2,186	(26.9)	
Hypertension					
Absent	-		6,652	(81.9)	
Present	-		1,475	(18.1)	
Diabetes					
Absent	-		7,571	(93.2)	
Present	-		556	(6.8)	
Dyslipidemia					
Absent	-		7,262	(89.4)	
Present	-		865	(10.6)	
Exposure to stroke-related public relations materials					< 0.001
No	6,309	(77.0)	5,758	(70.9)	
Yes	1,882	(23.0)	2,369	(29.1)	
Experience of stroke education					
No	-		7,504	(92.3)	
Yes	-		623	(7.7)	

Knowledge of stroke

In 2012 and 2014, the proportions of respondents aware of stroke warning signs were highest for sudden difficulty speaking or understanding speech (80.9% and 86.4%), followed, in order of magnitude, by sudden dizziness (70.3% and 75.3%), sudden numbness or weakness (70.5% and 71.4%), sudden visual impairment (56.8% and 62.0%), and sudden severe headache (52.3% and 57.4%). Compared with the recognition rates for each stroke warning sign in 2012, the recognition of warning signs (except numbness or weakness) increased significantly in 2014 (Fig. 1). The proportions of those aware of these five stroke warning signs were 6.4%, 6.8%, 13.3%, 21.5%, 27.0%, and 25.0% in 2012, and 5.6%, 5.3%, 10.8%, 18.6%, 29.0%, and 30.7% in 2014, with respect to knowledge of 0, 1, 2, 3, 4, and 5 warning signs, respectively. The proportion of respondents with high knowledge of stroke warning signs (≥ 4 correct warning signs) increased significantly from 52.0% in 2012 to 59.7% in 2014 ($P < 0.001$) (Fig. 2).

In total, 59.6% of the respondents in 2012 answered that they would call an ambulance when someone showed symptoms of stroke, compared to 67.1% of the respondents in 2014 ($P < 0.001$). Awareness of the need for prompt treatment for stroke increased from 86.7% in 2012 to 89.8% in 2014 ($P < 0.001$) (Table 2).

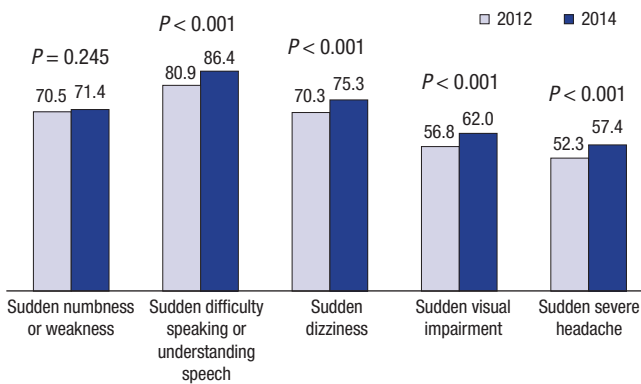


Fig. 1. Compared with the recognition rates for each stroke warning sign in 2012, the recognition of warning signs (except numbness or weakness) increased significantly in 2014 ($P < 0.001$). The respondents' awareness of stroke warning signs was highest for 'difficulty speaking or understanding speech' (80.9% in 2012 and 86.4% in 2014) and lowest for 'severe headache' (52.3% in 2012 and 57.4% in 2014).

Predicting factors for stroke awareness

The characteristics of the participants in 2014, according to knowledge of stroke warning signs and awareness of the need for prompt treatment, are listed in Table 3.

In a multivariate logistic regression analysis, the OR of females with high knowledge of stroke warning signs was significant (OR, 1.29; 95% CI, 1.15-1.46). Compared with the 20-39 years age group, the 40-59 years (OR, 1.18; 95% CI, 1.06-1.32) and 60-79 years (OR, 1.22; 95% CI, 1.03-1.45) age groups had significantly higher ORs of high knowledge. Those with higher education levels and higher household incomes had significantly higher ORs than those with lower education levels and lower household incomes, respectively. Current smokers (OR, 0.74; 95% CI, 0.70-0.99) had significantly lower ORs than never smokers. A diagnosis of stroke in the respondent or immediate family members (OR, 1.40; 95% CI, 1.23-1.59), and a diagnosis of stroke in acquaintances, relatives or neighbors (OR, 1.20; 95% CI, 1.08-1.33) were significantly associated with high knowledge. Hypertension (OR, 1.15; 95% CI, 1.01-1.31) was significantly associated with high knowledge, whereas diabetes and dyslipidemia were not. Those who had been exposed to stroke-related public relations materials (OR, 1.96; 95% CI, 1.76-2.19) had significantly higher ORs than those who had not been exposed to such

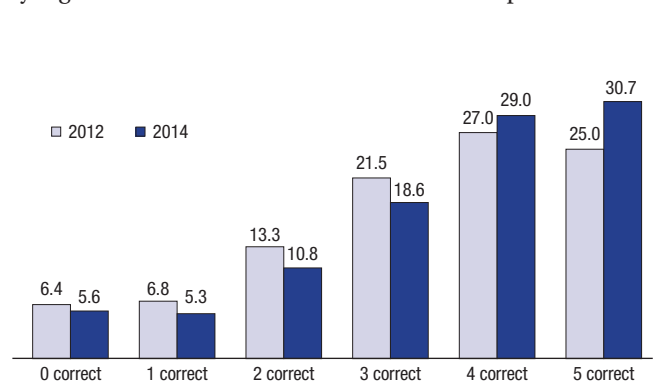


Fig. 2. The respective proportions of those who were aware of 0 to 5 stroke warning signs were 6.4%, 6.8%, 13.3%, 21.5%, 27.0%, and 25.0% in 2012 and 5.6%, 5.3%, 10.8%, 18.6%, 29.0%, and 30.7% in 2014. The proportion of respondents with high knowledge of stroke warning signs (≥ 4 correct warning signs) increased significantly from 52.0% in 2012 to 59.7% in 2014 ($P < 0.001$).

Table 2. Respondents' reaction to stroke warning signs and awareness of the need for the prompt treatment for stroke

	2012 (n = 8,191)		2014 (n = 8,127)		P value
	No.	(%)	No.	(%)	
Reaction to stroke warning signs					
Call an ambulance	4,879	(59.6)	5,455	(67.1)	< 0.001
Take them to a hospital	2,660	(32.5)	2,167	(26.7)	
Take them to an oriental medicine hospital	187	(2.3)	115	(1.4)	
Contact family	285	(3.5)	266	(3.3)	
Other actions	71	(0.9)	29	(0.4)	
Do not know	109	(1.3)	95	(1.2)	
Awareness of the need for prompt treatment					
No	1,089	(13.3)	833	(10.2)	< 0.001
Yes	7,102	(86.7)	7,294	(89.8)	

material. Also, those who had experienced stroke education (OR, 1.60; 95% CI, 1.32-1.95) had significantly higher ORs than those who had not (Table 4).

In multivariate logistic regression analysis, compared to the 20-39 years age group, the 40-59 years (OR, 2.48; 95% CI, 2.07-2.97) and 60-79 years (OR, 5.10; 95% CI, 3.67-7.09) age groups had significantly higher ORs of being aware of the need for prompt

treatment. Those with higher education levels and higher household incomes had significantly higher ORs than those with lower education levels and lower household incomes, respectively. Former and current smokers had significantly lower ORs than never smokers. Those who had been exposed to stroke-related public relations materials (OR, 2.45; 95% CI, 1.97-3.05) had significantly higher ORs than those who had not been exposed.

Table 3. Characteristics of respondents according to knowledge of stroke warning signs and awareness of the need for prompt treatment in 2014 (n = 8,127)

Characteristics	Knowledge of stroke warning signs			Awareness of the need for prompt treatment		
	Low [\leq 3/5 correct answers] (n = 3,272)	High [\geq 4/5 correct answers] (n = 4,855)	P value	Unaware (n = 833)	Aware (n = 7,294)	P value
Gender			< 0.001			0.443
Male	1,751 (53.5)	2,342 (48.2)		430 (51.6)	3,663 (50.2)	
Female	1,521 (46.5)	2,513 (51.8)		403 (48.4)	3,631 (49.8)	
Age group, yr			< 0.001			< 0.001
19-39	1,267 (38.7)	1,796 (37.0)		503 (60.4)	2,560 (35.1)	
40-59	1,224 (36.0)	2,177 (44.8)		235 (28.2)	3,166 (43.4)	
60-79	781 (22.3)	882 (18.2)		95 (11.4)	1,568 (21.5)	
Region			< 0.001			0.123
Rural	467 (14.3)	547 (11.3)		90 (10.8)	924 (12.7)	
Urban	2,805 (85.7)	4,308 (88.7)		743 (89.2)	6,370 (87.3)	
Education level			< 0.001			0.074
Primary school or lower	482 (14.7)	350 (7.2)		73 (8.8)	759 (10.4)	
Middle or high school	1,185 (36.2)	1,646 (33.9)		273 (32.8)	2,558 (35.1)	
College or higher	1,605 (49.1)	2,859 (58.9)		487 (58.5)	3,977 (54.5)	
Monthly household income, 10,000 won			< 0.001			0.016
\leq 200	1,174 (35.9)	1,204 (24.8)		257 (30.9)	2,121 (29.1)	
201-400	1,200 (36.7)	2,020 (41.6)		353 (42.4)	2,867 (39.3)	
\geq 401	898 (27.4)	1,631 (33.6)		223 (26.8)	2,306 (31.6)	
Smoking status			< 0.001			0.005
Never smokers	2,001 (61.2)	3,201 (65.9)		510 (61.2)	4,692 (64.3)	
Former smokers	604 (18.5)	847 (17.4)		138 (16.6)	1,313 (18.0)	
Current smokers	667 (20.4)	807 (16.6)		185 (22.2)	1,289 (17.7)	
Drinking status			0.042			0.002
Non drinkers	1,046 (32.0)	1,567 (32.3)		225 (27.0)	2,388 (32.7)	
Light drinkers	1,889 (57.7)	2,868 (59.1)		517 (62.1)	4,240 (58.1)	
Heavy drinkers	337 (10.3)	420 (8.7)		91 (10.9)	666 (9.1)	
History of stroke in respondent or immediate family			< 0.001			< 0.001
No	2,838 (86.7)	3,920 (80.7)		732 (87.9)	6,026 (82.6)	
Yes	434 (13.3)	935 (19.3)		101 (12.1)	1,268 (17.4)	
History of stroke in relatives, acquaintances, or neighbors			< 0.001			< 0.001
No	2,521 (77.0)	3,420 (70.4)		654 (78.5)	5,287 (72.5)	
Yes	751 (23.0)	1,435 (29.6)		179 (21.5)	2,007 (27.5)	
Hypertension			0.563			< 0.001
Absent	2,688 (82.2)	3,964 (81.6)		729 (87.5)	5,923 (81.2)	
Present	584 (17.8)	891 (18.4)		104 (12.5)	1,371 (18.8)	
Diabetes			0.005			0.247
Absent	3,017 (92.2)	4,554 (93.8)		784 (94.1)	6,787 (93.0)	
Present	255 (7.8)	301 (6.2)		49 (5.9)	507 (7.0)	
Dyslipidemia			0.233			< 0.001
Absent	2,940 (89.9)	4,322 (89.0)		779 (93.5)	6,483 (88.9)	
Present	332 (10.1)	533 (11.0)		54 (6.5)	811 (11.1)	
Exposure to stroke-related public relations materials			< 0.001			< 0.001
No	2,623 (80.2)	3,135 (64.6)		729 (87.5)	5,029 (68.9)	
Yes	649 (19.8)	1,720 (35.4)		104 (12.5)	2,265 (31.1)	
Experience of stroke education			< 0.001			< 0.001
No	3,111 (95.1)	4,393 (90.5)		810 (97.2)	6,694 (91.8)	
Yes	161 (4.9)	462 (9.5)		23 (2.8)	600 (8.2)	

Data are expressed as number (percentage).

Table 4. Adjusted odds ratios and 95% confidence intervals from multivariable logistic regression analysis for the factors related to high knowledge of warning signs and awareness of the need for prompt treatment for stroke in 2014

Characteristics	High knowledge of stroke warning signs (≥ 4/5 correct answers)	Being aware of the need for prompt treatment for stroke
Gender		
Male	1.00	1.00
Female	1.29 (1.15-1.46)	0.89 (0.74-1.07)
Age group, yr		
19-39	1.00	1.00
40-59	1.18 (1.06-1.32)	2.48 (2.07-2.97)
60-79	1.22 (1.03-1.45)	5.10 (3.67-7.09)
Region		
Rural	1.00	1.00
Urban	1.12 (0.97-1.29)	0.88 (0.69-1.12)
Education level		
Primary school or lower	1.00	1.00
Middle or high school	1.81 (1.50-2.19)	1.53 (1.09-2.16)
College or higher	2.41 (1.96-2.98)	1.73 (1.20-2.49)
Monthly household income, 10,000 won		
≤ 200	1.00	1.00
201-400	1.38 (1.21-1.58)	1.44 (1.18-1.76)
≥ 401	1.39 (1.20-1.60)	1.76 (1.41-2.19)
Smoking status		
Never smokers	1.00	1.00
Former smokers	0.94 (0.81-1.09)	0.74 (0.58-0.94)
Current smokers	0.86 (0.74-0.99)	0.70 (0.56-0.88)
Drinking status		
Non drinkers	1.00	1.00
Light drinkers	0.94 (0.84-1.05)	0.98 (0.82-1.17)
Heavy drinkers	0.84 (0.70-1.01)	0.90 (0.67-1.20)
History of stroke in respondent or immediate family		
No	1.00	1.00
Yes	1.40 (1.23-1.59)	1.14 (0.91-1.43)
History of stroke in relative, acquaintance, or neighbor		
No	1.00	1.00
Yes	1.20 (1.08-1.33)	1.14 (0.95-1.36)
Hypertension		
Absent	1.00	1.00
Present	1.15 (1.01-1.31)	1.11 (0.88-1.41)
Diabetes		
Absent	1.00	1.00
Present	0.90 (0.74-1.09)	0.82 (0.59-1.14)
Dyslipidemia		
Absent	1.00	1.00
Present	1.01 (0.86-1.18)	1.23 (0.91-1.66)
Exposure to stroke-related public relations materials		
No	1.00	1.00
Yes	1.96 (1.76-2.19)	2.45 (1.97-3.05)
Experience of stroke education		
No	1.00	1.00
Yes	1.60 (1.32-1.95)	2.04 (1.32-3.14)

Adjusted for gender, age group, region, education level, monthly household income, smoking status, drinking status, history of stroke in respondent or immediate family, history of stroke in relative, acquaintance, or neighbor, hypertension, diabetes mellitus, dyslipidemia, exposure to stroke-related public relations materials, and experience of stroke education.

Also, those who had experienced stroke education (OR, 2.04; 95% CI, 1.32-3.14) had significantly higher ORs than those who had not (Table 4).

DISCUSSION

In a representative sample of the Korean population, public

awareness of stroke warning signs and awareness of the need for prompt treatment significantly increased between 2012 and 2014. Among the general characteristics of the population, older age, higher education level, higher household income, current non-smoking status, exposure to stroke-related public relations materials, and stroke education were significantly associated with both high knowledge of stroke warning signs and aware-

ness of the need for prompt treatment.

Previous studies in Korea showed that numbness/weakness/ paresis was the most commonly recognized stroke warning sign (open-ended or closed-ended questions), followed by language disturbances and dizziness (13-16). Consistent with previous studies, difficulty speaking or understanding speech, dizziness, and numbness/weakness were the most commonly identified stroke warning signs in our study. Unlike previous studies, however, difficulty speaking or understanding speech was the warning sign most commonly identified in our study. Similar to the results of Korean studies, evidence from many countries has shown that numbness/weakness/paralysis, difficulty speaking or understanding speech, and dizziness were most common recognized stroke warning signs (9-11,18,19). Visual impairment and severe headache were the least commonly identified warning signs in the majority of previous studies, including those in Korea.

This study provides evidence of an improvement in the awareness of stroke warning signs, and the rate of recognition of the need for prompt treatment, among Koreans between 2012 and 2014 (a 2.8-year interval). There could be several reasons for these increases. From 2008 to 2012, 11 hospitals throughout Korea were gradually designated as Regional Cardiocerebrovascular Centers (RCCs), which were charged with decreasing the incidence and mortality of stroke and myocardial infarction (20). These RCCs have made an important effort to raise the public's awareness of stroke with a focus on warning signs, golden time, the need for prompt treatment, and response to warning signs through various community actions. The increase in the public's stroke awareness might be partly attributable to RCCs projects such as stroke-related public awareness campaigns, including billboards, radio, television, web sites, and public education on stroke, although it is difficult to identify the individual impact of these factors. Also, during the same period, the central government and academic societies for stroke may have contributed to the increase in the public's stroke awareness.

Previous international population-based studies have shown that various factors were associated with increased awareness of stroke warning signs (9,12,14,16,21-23), but only higher education was significantly associated in almost all studies. Our results identified many factors, including education level, that were associated with high knowledge of stroke warning signs. An Australian study found that awareness of advertising was significantly associated with higher awareness of stroke warning signs (12); however, a Nigerian study that examined health education on stroke showed it was not a predicting factor for increased awareness of stroke warning signs (9). Our results showed that stroke-related public relations materials and stroke education were effective interventions for increasing not only awareness of stroke warning signs but also awareness of the general need for prompt treatment for stroke.

This study had some limitations. First, the sample used does not represent the entire population of Korea, because it included only 600 people from each metropolitan city or province, which was proportionally distributed by gender and age. Second, awareness of stroke might have been overestimated because of the use of close-ended, not open-ended, questions. Third, although the public's awareness of stroke increased significantly, the follow-up period was relatively short (2.8 years). Therefore, the term 'temporal changes' rather than 'temporal trends' was used in this study. Future longitudinal studies with more than two time points are warranted to examine temporal trends in stroke awareness in Korea. Nevertheless, this study also had several strengths. First, this is the first large population study conducted in Korea that reported temporal changes in the public's awareness of stroke. Second, a large number of respondents from among the general population were included, which provided sufficient statistical power. Third, 20% of the total sample was surveyed via mobile phones to include the group without landline telephones, thereby minimizing selection bias.

In conclusion, the public's awareness of stroke in Korea was higher and has improved significantly between 2012 and 2014. To improve and maintain the public's awareness of stroke, and to reduce health inequality in stroke knowledge, more detailed and tailored strategies are needed at a regional or community level.

DISCLOSURE

The authors have no potential conflicts of interest to disclose.

AUTHOR CONTRIBUTION

Study design: Moon J, Lee YM, Park HK, Park KS, Yun YW, Kang G, Kim BG, Seo JH, Lee H, Lee WK, Lee KS, Kim HS. Data acquisition: Moon J, Lee YM, Park HK, Park KS, Yun YW, Kang G, Kim BG, Seo JH, Lee H, Lee WK. Data analysis: Oh GJ, Lee YH. Writing: Oh GJ, Lee YH. Review of manuscript: Oh GJ, Lee KS, Kim HS, Lee YH. Revision and approval of manuscript: all authors.

ORCID

Gyung-Jae Oh <http://orcid.org/0000-0001-9869-1564>

Jiyung Moon <http://orcid.org/0000-0001-9503-020X>

Yu-Mi Lee <http://orcid.org/0000-0003-3206-7894>

Hyeung-Keun Park <http://orcid.org/0000-0001-7502-5710>

Ki Soo Park <http://orcid.org/0000-0001-5571-3639>

Yong-Woon Yun <http://orcid.org/0000-0001-6715-1768>

Gilwon Kang <http://orcid.org/0000-0003-0222-1870>

Byoung-Gwon Kim <http://orcid.org/0000-0002-1762-6320>

Jae-Hee Seo <http://orcid.org/0000-0002-9166-9986>

Heeyoung Lee <http://orcid.org/0000-0003-4830-9851>

Won Kyung Lee <http://orcid.org/0000-0002-6014-8854>
 Kun Sei Lee <http://orcid.org/0000-0003-1552-6761>
 Hee-Sook Kim <http://orcid.org/0000-0002-4037-6227>
 Young-Hoon Lee <http://orcid.org/0000-0003-1367-025X>

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