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Facilitators of and barriers to emergency medical service use by acute ischemic stroke patients: A retrospective survey

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ABSTRACT

Objective: The objective of the study was to identify facilitators and barriers to emergency medical service use among acute ischemic stroke patients in Korea.
Methods: This paper presents a secondary analysis of a retrospective survey that collected data from questionnaires and medical records. Among 233 acute ischemic stroke patients enrolled in a large-scale study, 160 patients who had arrived at a hospital within 72 h after symptom onset were included in the data analysis.
Results: Users of emergency medical services needed a shorter time than non-users to arrive at hospital (140 min. vs. 625 min., $p = 0.001$) and were more likely to arrive at hospital within 3 h of symptom onset (51.9% vs. 31.5%, $p = 0.013$). For those who first contacted emergency medical service, the facilitators of emergency medical service use were the presence of hemiparesis ($p = 0.003$), bilateral paralysis ($p = 0.040$), and loss of balance ($p = 0.021$). The predominant barrier was the failure to recognize the urgency of symptoms ($p = 0.006$).
Conclusions: The use of emergency medical services reduced prehospital delay and increased the likelihood of patient arrival at hospital within 3 h. Given that experiencing typical stroke symptoms was a facilitator of emergency medical service use yet failure to recognize the urgency of symptoms was a barrier, public awareness should be raised as regards stroke symptoms and the benefits of using emergency medical services.

1. Introduction

Acute ischemic stroke (AIS) is one of the leading causes of mortality and disability in Korea and around the world [1—5]. With an estimated incidence of 11.6 million in 2010, AIS accounted for 10.4% of all deaths in Korea in 2010 [6] and19.6% of all deaths (3.3 million) worldwide in 2013 [4]. Disability among stroke patients is mainly due to delays in treatment, which often causes potentially preventable complications [7].

Emergency medical services (EMS) refers to ambulance and paramedic services that provide on-site assessment, basic or advanced life support outside the hospital, and transport of patients to a hospital. Although EMS has been proven to significantly improve the survival rates and treatment outcomes of AIS patients, many patients fail to use EMS and consequently fail to arrive at a hospital for reperfusion therapy within 3 h after symptom onset [8,9].

Although EMS use at the onset of AIS symptoms has been extensively investigated in the United States and Europe, few such studies have been conducted in the Korean context [10—14]. Compared with other strategies for reducing delays in AIS intervention, EMS use, as well as its associated factors, has received limited attention from clinicians and researchers in Korea. Furthermore, these few local studies did not examine the impacts of sociocultural and environmental factors on EMS use.

Therefore, this study investigated EMS use at the onset of AIS symptoms in the Korean population. Specifically, we examined the prevalence of EMS use on the basis of demographic characteristics, health and stroke history, symptom experience, and sociocultural and environmental factors. The objectives of this investigation were

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(1) to examine whether EMS use reduced decision time, transportation time, and overall prehospital time and (2) to identify the facilitators of and barriers to EMS use with respect to sociocultural (e.g., instinctively contacting one's adult child or a spouse instead of EMS, living with one's family, dependency on oriental medicine) and environmental (e.g., neighborhood where one lives) factors.

2. Background

In 2013, an approximately quarter of a million people in Korea died from stroke, indicating a stroke mortality rate of 50.3 per 100 000 [3], which is greater than that in the United States (40.8 per 100 000) [15]. In 2012, an estimated 795 000 Koreans aged at least 30 years old suffered from a stroke [1,16]. At present, reperfusion therapy using recombinant tissue plasminogen activator (tPA) administered intravenously is the main strategy employed to stop further brain damage and sustain cognitive and physical function following a stroke [17]. The National Institute of Neurological Disorders and Stroke (NINDS) recommends that reperfusion should be conducted within 3 h after symptom onset [18]. This recommendation is supported by the American Heart Association Stroke Council and the meta-analysis of nine randomized controlled trials, albeit with an extended time window of 4.5 h [19,20].

EMS can provide stoke patients with fast and safe transportation as well as prehospital care. However, many patients to use EMS and consequently fail to arrive at the hospital for reperfusion therapy within the recommended time window [21–23]. The reasons why patients in Korea fail to use EMS for AIS symptoms may differ from those of patients in Western countries because of Korea's unique sociocultural norms of familism and filial piety, which are rooted in Confucianism [24,25]. Familism is a social pattern in which the family assumes a position of ascendance over individual interests [26]. In contrast to modern Western societies, wherein the autonomy of each individual is highly valued, the idea of family takes precedence over individual autonomy in Asian cultures, even for medical decision making [27–30]. Given that familism is an intrinsic concept in the Korean society, a patient may hesitate to contact EMS without first discussing his/her AIS symptoms with family members, such that the family can collectively decide.

In Confucian philosophy, filial piety (Chinese:孝, xiào) refers to the virtue of respect for one's parents, elders, and ancestors; this practice is highly valued in Asian cultures [25,29,30]. Filial piety is rooted in Confucian role ethics, which dictates that, on the one hand, adult children are responsible for caring for their parents, especially when they are ill [29]. On the other hand, parents must instill filial piety in their children by allowing their children to take care of them. Filial piety mandates that adult children—typically, the firstborn son—is responsible for making the important medical-related decisions, such as those pertaining to parental illness. Nonetheless, no study has investigated whether familism and filial piety influence EMS use among AIS patients.

Korean stroke patients tend to rely on oriental medicine, which is often referred to as Korean medicine (한의학, 韓醫學). Previous studies found that a significant proportion of patients visited an oriental medicine clinic before going to the hospital, and that this additional stop lengthened prehospital time [21,31]. Moreover, patients residing in rural and urban areas may substantially differ in terms of stroke symptom awareness and EMS availability.

This study expands the knowledge on prehospital delay in the Korean context by considering sociocultural and environmental factors in addition to the common factors apparent in the United States and Europe settings. The findings of this study can serve as basis for developing strategies for improving EMS use in Korea. Our findings can also help clinicians and researchers in other countries, particularly where familism and filial piety are prevalent practices as well.

3. Methods

3.1. Design, setting, and sample

This work is a secondary analysis of a retrospective survey that was conducted using a structured interview at an urban hospital in Jeonju, which is the capital city of Jeolla-bukdo Province. Located in southwest Korea, this city is known for preserving tradition values over its thousand-year-old history. Jeonju has an area of 206.22 km^2 (79.62 sq mi) and a population of 653 887 in 2014 [32]. A total of 71 EMS cover Jeolla-bukdo Province, which has a total area of 8067 km^2 (3114.68 sq mi) and a population of 1 871 560 in 2014, indicating that one EMS covers 26 260 people [33,34]. The 2014 EMS/population ratio is lower in neighboring provinces: one per 21 275 in Jeolla-namdo Province and one per 24 671 in Chungchung-bukdo Province [33]. In Korea, the telephone number 119 is reserved to EMS and EMS transportation is free of charge to the public; therefore placing a call to EMS should not be difficult [33]. Among 233 patients who were enrolled in a large-scale study, 160 patients who had arrived at the hospital within 72 h after symptom onset were included in the data analysis. Details about the large-scale study are reported elsewhere [35]. Briefly, the inclusion criteria of the 233 patients were as follows: diagnosed with nontraumatic AIS by brain-computed tomography or magnetic resonance imaging; had been admitted to the hospital for at least one month; and had no severe cognitive impairment or communication difficulties, as determined by neurologists at the hospital. The 72 h time window was selected for convenient comparison with the studies conducted in the United States and Europe [8,9,12].

3.2. Data collection

Institutional review board approval was acquired prior to recruitment and enrollment. Upon obtaining informed consent, two trained research associates conducted a structured interview from August 2011 to February 2012 to gather information on demographics (sex, age, marital status, educational level, and household income), existing health conditions (hypertension, diabetes, and hypercholesterolemia), health-risk behaviors (less than 3 d per week of physical activity, smoking, and alcohol use), family or patient history of stroke, whether they contacted EMS, and the type of vehicle used to go to the hospital. During the interviews, spouses or adult children were permitted to assist the patients or to supplement their recollection regarding when symptoms were recognized, whether EMS was called (if so, when), and when and how did the patient arrive at the hospital. A medical record audit was conducted to obtain clinical data, such as confirmatory diagnostic procedures, final diagnosis, emergency department arrival time, and the presence of hypertension, diabetes, or hypercholesterolemia.

Information about symptom experience was collected using a questionnaire adapted from a nationwide survey of stroke awareness and the clinical practice guidelines for stroke in Korea [1,36]. The questionnaire inquired about sociocultural factors (e.g., the person first contacted when the patient recognized the symptoms, the first place where the patient presented with AIS symptoms) and environmental factors (e.g., lived in an urban or rural area, lived alone or with others). Two items in the survey were concerned about the patients' preference for oriental medicine: (1) whether they perceived oriental medicine necessary for stroke care; and (2) whether they preferred to under stoke care in an oriental medical facility or a conventional medical center.

We gathered data on two time intervals: (1) decision time,

which is the interval between the time at which the patient recognized the symptoms and the time at which the patient decided to seek medical attention; and (2) the transportation time, which is the interval between the time at which the patient left the location where the stroke occurred and the time at which the patient arrived at the hospital. We then analyzed the overall prehospital time, which is defined as the interval between the time of symptom onset and the arrival time at the hospital.

3.3. Data analysis

Descriptive statistical analysis was conducted to summarize the sample characteristics. Chi-square tests were conducted to examine the differences between EMS users and non-EMS users in terms of demographic characteristics, health and stroke history, patient's and family's recognition of stroke symptoms, patients' perception of the causes for prehospital delay, manifested symptoms, and sociocultural and environmental factors.

T-tests and Mann-Whitney U tests were employed to examine the differences between the EMS users and non-EMS users in terms of decision time, transportation time, and overall prehospital time. Mann-Whitney U tests were used as an alternative to independent sample t-tests, because prehospital times (decision time, transportation time, and overall prehospital time) were not normally distributed. Multivariate logistic regression was performed to identify the predictors of EMS use. Odd ratios (OR) and confidence intervals (CI) associated with EMS use were calculated. Prior to conducting multivariate analysis, we conducted univariate analysis on each independent variable and selected only those with $p < 0.10$ (i.e., presence of hemiparesis, having trouble speaking, loss of balance, failure to recognize the urgency of symptoms, family's failure to take the symptoms seriously) for multiple regressions. A p value less than 0.05 was considered statistically significant. All statistical analyses were conducted using SPSS for Windows, Version 22.0 (SPSS Inc. Chicago, IL, USA).

4. Results

4.1. Sample characteristics

Table 1 summarizes the comparisons of EMS users and non-EMS users in terms of demographic characteristics, health and stroke history, symptom recognition, perceived causes for prehospital delay, manifested symptoms at the hospital, and sociocultural and environmental factors. Among 160 AIS participants, approximately one-third ($n = 52$) used EMS. The results indicated that EMS use was not associated with demographic characteristics, health history, family history of stroke, or patient history of stroke. Nearly one-third (31.9%) indicated that the delay in arriving at the hospital was caused their failure to recognize the urgency of the symptoms; non-EMS users were more likely to state this reason than EMS users ($p = 0.006$).

Among the common AIS symptoms, hemiparesis was reported by 51.9% of EMS users and 27.8% of non-EMS users ($p = 0.003$). The patients responded that upon perceiving AIS symptoms, the person first they contacted was their adult child (47.2%), followed by their spouse (36.9%); only 1.9% first contacted EMS. No significant difference in EMS use was observed between patients who first contacted their adult children and those who contacted their spouse; however, the former presented a higher percentage of not using EMS than the latter (51.9% vs. 37.3%). Approximately two-thirds (68.6%) of patients first went to an emergency department; these patients comprised more EMS users than non-EMS users ($p = 0.001$).

4.2. Prehospital time by EMS users

Table 2 shows the differences between EMS users and non-EMS users in terms of decision time, transportation time, and overall prehospital time (in min). Both the decision time (120 min vs. 480 min) and the overall prehospital time (140 min vs. 625 min) were significantly shorter in EMS users than in on-EMS users ($p < 0.001$); no significant difference was found in transportation time. Overall, 38.1% of patients arrived at the hospital within 3 h; these patients comprised more EMS users than non-EMS users ($p = 0.013$). Logistic regression analysis revealed that AIS patients were more likely to use EMS when they experienced hemiparesis (OR 2.632, 95% CI 1.219 to 5.683, $p = 0.014$) but less likely to use EMS when they failed to recognize the urgency of the symptoms (OR 0.388, 95% CI 0.162 to 0.926, $p = 0.033$).

5. Discussion

This study revealed that EMS is underused for AIS in Korea. Less than one-third (32.5%) used EMS, and more than two-thirds (67.5%) failed to use EMS and consequently delayed their arrival at the hospital. This finding is of great concern, because prehospital delay (beyond the treatment time window) is linked to worse health outcomes among stroke patients and warrants intervention efforts. EMS use is reportedly the most significant and consistent factor associated with reduced prehospital delays among AIS patients [13,37–39]. The EMS use rate in our study is considerably lower than the reported 40%–50.9% in the United States [37,40] and 49% in Germany [38], but it is greater than that in a previous study (only 18% used EMS for AIS) conducted in southeast Korea [36]. The EMS use rate in this study is also slightly higher than the reported values by studies in Taiwan (30.4%) [41] and Japan (7.8%–8.5%) [42].

The prehospital time of EMS users was less than one-fifth of the overall prehospital time of non-EMS users ($Mdn = 140$ min vs. 625 min). The decision time of EMS users to seek medical treatment was only one-fourth of the decision time of non-EMS users took ($Mdn = 120$ min vs. 480 min, $p < 0.001$). The shorter decision time of EMS users indicates that the earlier that the decision was made, the greater is the likelihood that they would call EMS. In addition, a greater number of EMS users than non-EMS users first went to an emergency department ($p = 0.001$). EMS use shortens prehospital time, because the patients go directly to an emergency department, where they promptly receive medical attention for diagnosis and treatment. By contrast, non-EMS users are more likely to visit outpatient clinics or physician offices before ultimately going to a hospital. Among EMS users, 51.9% and 61% arrived at the hospital within 3 and 4.5 h, respectively; these values are close to the reported percentage of patients who received thrombolysis therapy within the treatment time window in the United States.

Our data confirmed that the number of AIS patients receiving noninvasive thrombolysis therapy increases when the patients used EMS. We were unable to confirm a number of known predictors of EMS use (e.g., younger age, living with family, or higher education), although these factors have been identified in previous studies [13,38,39,43]. The lack of significant associations between the previously established socioenvironmental factors and EMS use may be due to the overall homogeneity of the participants: 97.5% were married, and 81% lived with their spouse and/or their family. In our study, the majority of patients first contacted their adult children (47.2%) or their spouse (37.1%), and only 1.9% first contacted EMS. These findings possibly reflect the sociocultural norms of familism and filial piety that are practiced in the Korean society; that is, older adults largely depend on their adult children for making major decisions about their health [27,29]. Medical decision making based on familism is a common scenario in most of Asian

Table 1
EMS use by sample characteristics ($N = 160$).

Characteristics[a]	Valid n (%)			χ^2/t	p
	EMS user $(n = 52)$	Non-EMS user $(n = 108)$	Total $(N = 160)$		
Demographic characteristics					
Sex: Male	32 (61.5)	58 (53.7)	90 (56.3)	0.876	0.349
Age (years)	71.0 ± 10.41	67.59 ± 10.72	68.70 ± 10.71	1.90	0.059
Marital status: Married	51 (98.1)	105 (97.2)	156 (97.5)	0.105	0.746
Educational level:					
≤Middle school	30 (58.8)	60 (55.6)	90 (56.6)	0.151	0.698
Income[b]					
<1 000 000 KRW	32 (61.5)	60 (57.1)	92 (58.6)	0.277	0.599
Health history					
Physical inactivity	33 (64.7)	67 (62.0)	100 (62.9)	0.106	0.745
Hypertension	26 (50.0)	62 (58.3)	89 (55.6)	0.987	0.320
Smoking	25 (48.1)	37 (34.3)	62 (38.8)	2.824	0.093
Diabetes	13 (26.0)	29 (27.4)	42 (26.9)	0.032	0.858
Hypercholesterolemia	8 (15.7)	21 (20.0)	29 (18.6)	0.422	0.516
Alcohol drinking	4 (7.7)	10 (9.3)	14 (8.8)	0.108	0.743
Stroke history					
Past history of stroke	13 (31.0)	21 (31.0)	34 (32.5)	0.637	0.418
Family history of stroke	15 (29.4)	37 (34.3)	52 (32.7)	0.270	0.543
Symptom recognition: "Symptoms not taken seriously" ($n = 158$)					
By patient	16 (30.8)	41 (38.7)	57 (36.1)	1.826	0.401
By family	6 (11.8)	21 (19.8)	27 (17.2)	5.696	0.058
Hospital arrival was delayed because ($n = 157$)					
Unclear symptoms	11 (21.2)	17 (15.7)	28 (17.5)	0.712	0.399
Not recognized urgency	9 (17.3)	42 (38.9)	51 (31.9)	7.528	0.006
Presenting symptoms ($n = 160$)					
Hemiparesis	27 (51.9)	30 (27.8)	57 (35.6)	8.923	0.003
Troubling in speaking	23 (44.2)	57 (52.8)	80 (50.0)	1.026	0.311
Dizziness	21 (40.4)	34 (31.5)	55 (34.4)	1.233	0.267
Numbness on face/extremities	14 (26.9)	41 (38.0)	55 (34.4)	1.896	0.168
Troubling in walking	13 (25.0)	18 (16.7)	31 (19.4)	1.560	0.212
General weakness	10 (19.2)	17 (15.7)	27 (16.9)	0.305	0.581
Characteristics[a]	EMS user $(n = 52)$	Non-EMS user $(n = 108)$	Overall $(N = 160)$	χ^2	p
Presenting symptoms ($N = 160$)					
Vomiting	8 (15.4)	10 (9.3)	18 (11.3)	1.319	0.251
Headache	6 (11.5)	16 (14.8)	22 (13.8)	0.318	0.573
Trouble seeing ($n = 159$)	5 (9.6)	7 (6.5)	12 (7.5)	0.474	0.491
Disorientation to person	5 (9.6)	3 (2.8)	8 (5.0)	3.455	0.063
Loss of consciousness	5 (9.6)	5 (4.6)	10 (6.3)	1.489	0.222
Loss of balance	4 (7.7)	1 (0.9)	5 (3.1)	5.308	0.021
Nausea	3 (5.8)	7 (6.5)	10 (6.3)	0.030	0.862
Amnesia	3 (5.8)	3 (2.8)	6 (3.8)	0.870	0.351
Paralysis in both extremities	2 (3.8)	0 (0)	2 (1.3)	4.206	0.040
Tremor	1 (1.9)	3 (2.8)	4 (2.5)	0.105	0.746
Stroke occurred					
While alone	21 (40.4)	36 (34.0)	57 (36.1)	0.624	0.430
While sleeping or resting	16 (31.4)	22 (20.6)	38 (24.1)	2.210	0.137
Sociocultural and environmental factors ($n = 159$)					
Person first contacted					
Spouse	20 (38.5)	39 (36.1)	59 (36.9)	0.083	0.773
Child	19 (37.3)	56 (51.9)	75 (47.2)	2.962	0.085
EMS	3 (5.9)	0 (0)	3 (1.9)	6.475	0.011
First place visited ($n = 109$)					
Emergency department	45 (86.5)	64 (59.8)	109 (68.6)	11.594	0.001
Belief in oriental medicine	15 (28.8)	25 (23.1)	40 (25.0)	0.608	0.436
Preferred oriental medicine	1 (1.9)	1 (0.9)	2 (1.3)	0.280	0.870
Residence: Living in rural area	29 (55.8)	61 (57.0)	90 (56.3)	0.022	0.882
Living alone	6 (11.5)	25 (23.1)	31 (19.4)	3.029	0.082

Note:
[a] All variables except age were coded as binomial.
[b] Family monthly income in Korean Won (1 00 0000 KRW ≈ US $920 at the time of the study).

countries [28,29]. Nonetheless, contacting one's adult children or spouse did not increase the odds of using EMS.

In this study, experiencing serious symptoms, such as hemiparesis, and recognizing the urgency of the symptoms were significant predictors of EMS use. This finding is consistent with recent findings that recognizing stroke symptoms and experiencing atrial fibrillation were associated with a hospital arrival within 3 h after symptom onset [11]. Kleindorfer et al. [40] conducted another large-population study consisting of 2975 stroke/transient ischemic attack patients to investigate which AIS symptoms prompt 911 calls; they reported that the symptoms associated with 911 calls were weakness, confusion or decreased level of

Table 2
Prehospital time and arrivals within treatment time window by EMS use ($N = 160$).

Time	Median (minutes)			p^a
	EMS user ($n = 52$)	Non-EMS user ($n = 108$)	Total ($N = 160$)	
Decision time[b]	120	480	360	<0.001
Transportation time[c]	30	20	30	0.287
Overall prehospital time[d]	140	625	385	0.001
	EMS user n (%)	Non-EMS user n (%)	Total n (%)	χ^2	p
Arrived at the hospital within 3 or 4.5 h					
<3 h[e]	27 (51.9%)	34 (31.5%)	61 (38.1)	6.217	0.013
<4.5 h[f]	32 (61.0%)	40 (37.0%)	72 (45.0)	8.514	0.004

Note:
[a] p-values for Mann-Whitney U test.
[b] Time from symptom onset to the decision to go to the hospital.
[c] Time from leaving home to arrival at the hospital.
[d] Time from symptom onset to arrival at the hospital.
[e] National Institution of Neurological Disorders and Stroke–recommended time window for an intravenous tPA.
[f] American Heart Association Stroke Council–recommended time window for an intravenous tPA.

consciousness, speech difficulty, and dizziness/lack of coordination/vertigo.

The facilitators of and barriers to EMS use in this study were similar to those found in a recent qualitative study conducted in the United States. Beckett et al. [44] investigated the perspectives of patients toward the facilitators of and barriers to seek treatment urgently. They found that in addition to social support and knowledge/ability to call EMS, other facilitators of urgent treatment-seeking behavior were classic AIS symptoms, severity of symptoms, sudden symptom onset, and a high perceived level of urgency. Meanwhile, the barriers to urgent treatment-seeking behaviors included atypical symptoms, mild symptoms, gradual symptom onset, and a low perceived level of urgency.

These findings indicate the need for public education strategies to improve EMS use by AIS patients. These strategies should include raising public awareness about the importance of arriving early at the hospital via EMS as soon as stroke symptoms manifest. In addition, the availability of national EMS should be expanded to rural areas. Public education should be targeted toward high-risk populations, such as hypertensive individuals and their family members (e.g., spouse, adult children), to improve their ability to identify stroke symptoms and recognize the urgency of contacting EMS. Older patients should also be made aware of the importance of contacting EMS rather than rely on their adult children or other family members to make decisions on their behalf. The traditional Korean practices and values of familism and filial piety must not take priority over medical emergencies. Adult children should call EMS instead of escorting their ill parents to a hospital by themselves, particularly when the symptoms require immediate medical attention.

Interestingly, EMS use was not influenced by family or patient history of stroke, even though these individuals are familiar with stroke symptoms and can recognize the urgency of the symptoms. The results implied that patients might still delay hospital treatment even if they had a recurrent stroke. One in four individuals experience a recurrent stroke within their lifetime—40% within 5 years of a first stroke—and a recurrent stroke presents a higher mortality. Therefore, the importance of rapid response to symptoms and early arrival at the hospital should be instilled in patients and their families, even in those who have already experienced a stroke [45].

The contribution of this study is its identification of the impacts of EMS use in two different phases of prehospital time and its use of a detailed survey to identify the facilitators of and barriers to EMS use with respect to sociocultural and environmental factors. To our knowledge, this study is the first effort to identify the facilitators of and barriers to EMS use among AIS patients in Korea within the context of sociocultural and environmental factors. Moreover, by conducting this study in an understudied region in southwest Korea, we expand the previous findings obtained by major studies conducted in metropolitan areas in Korea.

A limitation of this study is the representativeness of the sample, because the data were collected in only one regional hospital. Recall error or bias might be another limitation, because we depended mainly on the recollection of patients and their families, who had just gone through a stressful life event. The fact that EMS transportation is free of charge to the public in Korea suggests that the underuse of EMS is not associated with its cost but with other reasons (e.g., cultural factors). Therefore, future studies should further explore the reasons why people did not use EMS.

6. Summary and conclusions

The findings of this study demonstrate that EMS is underused by AIS patients. EMS use significantly shortened the overall prehospital time and increased the likelihood of arriving at the hospital for thrombolysis treatment within the recommended time window. Familism and filial piety are still highly valued and practiced in Korea, as evidenced by the finding that stroke patients tended to first contact their adult children or spouses. However, contacting family members neither facilitated EMS use nor shortened prehospital delay. Experiencing serious symptoms (e.g., hemiparesis) and recognizing the urgency of symptoms were key predictors of EMS use. Thus, stroke awareness education for the public and high-risk individuals should include information about the symptoms of stroke and the importance of arriving early at the hospital by using EMS.

Conflicts of interest

For the authors, no potential or actual conflicts of interest were declared.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ijnss.2016.12.008.

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