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Effects of Public Education by Television on Knowledge of Early Stroke Symptoms Among a Japanese Population Aged 40 to 74 Years

A Controlled Study

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Background and Purpose—An educational campaign by mass media has been associated with great increases in the knowledge about early symptoms of stroke. However, few studies were conducted with a controlled community intervention study.

Methods—To clarify the effects of a 1-year television campaign for the whole population on improvement of knowledge about stroke symptoms in 2 cities, a campaign area and a control area in Japan were selected. Before and after the campaign, 1960 randomly selected residents aged 40 to 74 years answered a telephone survey regarding knowledge of early stroke symptoms. We calculated the percentage and 95% CIs of participants who correctly chose all 5 early symptoms of stroke in each area and in each year.

Results—Before the campaign, 53% of participants (95% CI, 50%–55%) in the campaign area and 46% (95% CI, 44%–49%) in the control area correctly chose 5 early symptoms. After the 1-year television campaign, knowledge was significantly improved only in the campaign area (campaign area, 63%; 95% CI, 60%–66%; control area, 51%; 95% CI, 48%–54%). After sex stratification, only women showed improved knowledge of early symptoms. The audience rate for the campaign television programs was found to be higher in women than in men.

Conclusions–A 1-year stroke educational television campaign effectively improved knowledge about early stroke symptoms among Japanese women aged 40 to 74 years. No impact was found among men in this age group. Future studies should examine the impact of this approach on stroke knowledge among younger individuals and whether there are any behavioral changes that contribute to earlier presentation for treatment. (***Stroke.*** **2012;43:545-549.)**

Key Words: acute stroke ■ educational campaigns ■ knowledge ■ prevention ■ symptoms ■ warning signs

Delayed access to medical care in patients with stroke is associated with poor outcome. Knowledge of the early symptoms of stroke and the need to call an ambulance should therefore be widespread. The importance of ensuring timely treatment has grown dramatically since the introduction of thrombolytic treatment with tissue-type plasminogen activator[1–3] for cerebral infarction.

Various strategies for community education have been examined in previous studies.[4–8] Some reports have noted that television campaigns show greater efficacy for public education than other media.[4,6] However, few controlled studies have evaluated the effects of community education by television on knowledge about the early symptoms of stroke.[7] Furthermore, to our knowledge, there is no community education by television for stroke in Asian countries, where mortality due to stroke is high.[9]

The purpose of this study was to verify that television campaign could improve knowledge about early symptoms of stroke.

Methods

Study Setting

A community intervention providing information on early symptoms of stroke was conducted by television. The preintervention survey was performed in April 2009 and the postintervention survey was performed in April 2010. Because mortality of stroke varies between

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Table 1. Exposure to Intervention During the Campaign Period Among Participants in the Campaign Area: Postintervention Telephone Survey 2010

	Exposure to Intervention, No. (%)			
		Sex Differential		
Educational Intervention by Television	Overall (n = 968)	Men (n = 484)	Women (n = 484)	*P**
1-min spots†	381 (39.8)	161 (33.3)	220 (45.5)	<0.001
Highlight programs‡	274 (28.3)	108 (22.3)	166 (34.3)	<0.001
Both of 1-min spots† and highlight programs‡	207 (21.4)	74 (15.3)	133 (27.5)	<0.001
At least 1 of 1-min spots† and highlight programs‡	447 (46.2)	195 (40.3)	252 (52.2)	<0.001

*P value for χ^2 test.

†One-min spots: approximately 900 times of TV spots about stroke, each airtime was 60 s.

‡Highlight programs: a total of 60 times of documentaries and reports about stroke, each airtime was 5–15 min.

western and eastern Japan, 2 cities were selected from adjoining prefectures located in western Japan: Okayama city in Okayama prefecture for the campaign area and Kure city in Hiroshima prefecture for the control area.

A local branch of Japan Broadcasting Corporation (NHK, the largest noncommercial broadcasting in Japan) produced a series of television programs for the present study and broadcast them throughout the 1-year campaign period from April 2009. Okayama city was located in the broadcasting area of this local branch (Okayama broadcasting station of NHK). Residents living in the control area had few chances to watch these educational contents, because contents of broadcasting of a local branch of NHK vary by prefectures, and 2 cities do not have a common border and are located far from each other (approximately 150 km).

Participants

Sample size was calculated based on our previous surveys without television programs.[10] The number of participants required was estimated to be 780 people for each area (α=0.05, β=0.8). We decided to recruit approximately 1000 people from both areas for each of pre- and postintervention surveys.

Potential participants were randomly selected from the telephone directory in each area in each survey. A telephone survey was then continued until 140 complete interviews had been obtained for both men and women in their 40s, 50s, and 60s; and 70 complete interviews had been obtained for both men and women at 70 to 74 years old. A total of 3920 citizens were surveyed to find 980 in the campaign area and 980 in the control area for each pre- and postintervention survey. Approximately two thirds of available contacts were nonrelevant contacts, representing contacts with individuals <40 years old or ≥75 years old. Because the population was aged 40 to 74 was 300 389 in the campaign area and 114 670 in the control area in 2009, the sampling rate was approximately 0.33% and 0.85%, respectively.

Community Education

Because television programs produced by NHK are systematically distributed, similar television programs are broadcast by all local branches of NHK. However, sometimes slots are at the discretion of the local branch, such as 1-minute spots before serial dramas or 15-minute slots for local news before national news programs. The television campaign in the present study was thus mainly performed using these time slots.

The major points of the campaign by television programs were as follows. The first point was to make broadcasting content based on accurate scientific evidence. The second point was to provide repeated audiovisual information, that is, 1-minute spots were broadcast at least twice almost everyday, whereas highlight programs were broadcast at least once a week. Both types of programs were continued throughout the study period from April 2009 to March 2010.

The Okayama broadcasting station for NHK, Kawasaki Medical School, and the Japan Stroke Association supervised the campaign programs. The 1-minute spots comprised a total of 10 versions covering stroke, both of early symptoms and risk factors, prevention, up-to-date medical treatments, and rehabilitation. Highlight programs featuring 33 topics were broadcast during the campaign period.

Main Outcome Measures

Participants were asked to choose which of 10 listed symptoms fit as early symptoms of stroke. The 10 symptoms listed consisted of 5 early symptoms of stroke[11] and 5 incorrect or atypical symptoms ("sudden nasal bleeding," "sudden hot flush," "sudden pain in the left shoulder," "numbness or palsy of both hands and/or fingers," and "sudden difficulty breathing").

At the postintervention survey in the campaign area, participants were also asked whether they had seen any of the television spots and special programs.

Statistical Analysis

We estimated 95% CIs of population proportions for those who correctly chose all 4 early symptoms of stroke in surveys according to F-distribution. Sex-specific analysis was also performed. Participants who chose all 10 symptoms (n=45) were excluded from these analyses.

Results

Response rates of telephone surveys were 31.6% and 34.7% for pre- and postintervention surveys in the campaign area and 30.3% and 35.5% in the control area, respectively. In the postintervention survey in the campaign area, approximately 40% of participants reported "I saw some of the 1-minute spots about stroke on NHK between April 2009 and March 2010," whereas 30% reported seeing the highlight programs (Table 1). These audience rates for both types of programs were significantly higher for women than for men.

Proportions of participants who correctly chose 5 early symptoms are shown in Table 2. In all groups, regardless of area or sex, we observed tendencies toward improvement in knowledge about early symptoms of stroke; however, 95% CIs of those proportions demonstrated that only the campaign area showed a significant improvement in stroke knowledge (Figure). After sex stratification, only women in the campaign area showed a significant improvement (Figure).

In addition, the participants who watched either program had better knowledge about early symptoms of stroke (age- and sex-adjusted ORs and 95% CIs, 1.41 and 1.07–1.86).

Table 2. Proportion of Participants Who Correctly Chose 5 Early Symptoms of Stroke

	Campaign Area		Control Area	
	Preintervention 2009	Postintervention 2010	Preintervention 2009	Postintervention 2010
Overall				
No. of participants	965	968	971	971
Correct answer about stroke symptoms (%)				
Sudden numbness or weakness of the face, arm, or leg	868 (89.9)	869 (89.9)	805 (82.9)	812 (83.6)
Sudden confusion or trouble speaking or understanding others	907 (94.0)	901 (93.1)	895 (92.9)	879 (90.5)
Sudden trouble seeing with 1 or both eyes	674 (69.8)	764 (78.9)	651 (67.0)	642 (66.1)
Sudden dizziness, walking difficulties, or loss of balance or coordination	806 (83.5)	815 (84.2)	756 (77.9)	787 (81.1)
Sudden severe headache with no known cause	810 (83.9)	821 (84.8)	773 (79.6)	812 (83.6)
No. of selected correct answer about stroke symptoms (%)				
None	24 (2.5)	41 (4.2)	34 (3.5)	47 (4.8)
1	13 (1.3)	14 (1.4)	33 (3.4)	33 (3.4)
2	43 (4.5)	23 (2.4)	44 (4.5)	35 (3.6)
3	83 (8.6)	59 (6.1)	129 (13.3)	89 (9.2)
4	293 (30.4)	222 (22.9)	283 (29.1)	273 (28.1)
5*	509 (52.7)	609 (62.9)	448 (46.1)	494 (50.9)
Men				
No. of participants	478	484	484	486
Correct answer about stroke symptoms (%)				
Sudden numbness or weakness of the face, arm, or leg	422 (88.3)	421 (87.0)	389 (80.4)	388 (79.8)
Sudden confusion or trouble speaking or understanding others	444 (92.9)	437 (90.3)	437 (90.3)	429 (88.3)
Sudden trouble seeing with 1 or both eyes	342 (71.5)	365 (75.4)	328 (67.8)	325 (66.9)
Sudden dizziness, walking difficulties, or loss of balance or coordination	386 (80.8)	386 (79.8)	350 (72.3)	373 (76.7)
Sudden severe headache with no known cause	399 (83.5)	400 (82.6)	364 (75.2)	399 (82.1)
No. of selected correct answer about stroke symptoms (%)				
None	14 (2.9)	28 (5.8)	23 (4.8)	28 (5.8)
1	7 (1.5)	12 (2.5)	25 (5.2)	19 (3.9)
2	23 (4.8)	14 (2.9)	23 (4.8)	24 (4.9)
3	50 (10.5)	30 (6.2)	65 (13.4)	47 (9.7)
4	130 (27.2)	121 (25.0)	138 (28.5)	134 (27.6)
5*	254 (53.1)	279 (57.6)	210 (43.4)	234 (48.1)
Women				
No. of participants	487	484	487	485
Correct answer about stroke symptoms (%)				
Sudden numbness or weakness of the face, arm, or leg	446 (91.6)	448 (92.6)	416 (85.4)	424 (87.4)
Sudden confusion or trouble speaking or understanding others	463 (95.1)	464 (95.9)	458 (94.0)	450 (92.8)
Sudden trouble seeing with 1 or both eyes	332 (68.2)	399 (82.4)	323 (66.3)	317 (65.4)
Sudden dizziness, walking difficulties, or loss of balance or coordination	420 (86.2)	429 (88.6)	406 (83.4)	414 (85.4)
Sudden severe headache with no known cause	411 (84.4)	421 (87.0)	409 (84.0)	413 (85.2)
No. of selected correct answer about stroke symptoms (%)				
None	10 (2.1)	13 (2.7)	11 (2.3)	19 (3.9)
1	6 (1.2)	2 (0.4)	8 (1.6)	14 (2.9)
2	20 (4.1)	9 (1.9)	21 (4.3)	11 (2.3)
3	33 (6.8)	29 (6.0)	64 (13.1)	42 (8.7)
4	163 (33.5)	101 (20.9)	145 (29.8)	139 (28.7)
5*	255 (52.4)	330 (68.2)	238 (48.9)	260 (53.6)

*This proportion was defined as "participants who have knowledge about early symptoms of stroke" in the present study.

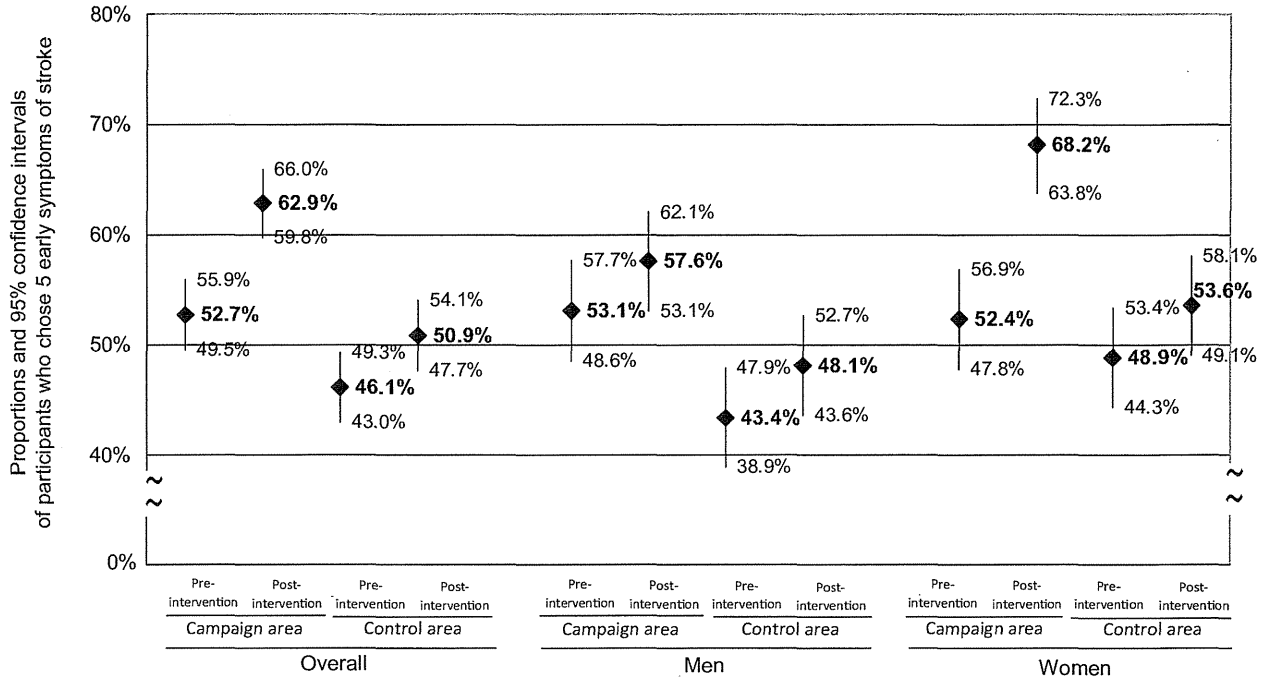

Figure. Overall and sex-stratified proportions and 95% confidence intervals (CIs) for participants who correctly chose 5 early symptoms of stroke before and after community education. Lozenge points indicate proportions of participants who correctly chose 5 early symptoms of stroke. Flickers indicate 95% CIs.

Discussion

This study is the first study of community education of stroke early symptoms in an Asian country. One advantage of the present study was the evaluation of the efficacy of television programs in the controlled trial with all participants randomly selected from the populations of the 2 areas. Another advantage was the use of a 1-year campaign, in which medically accurate contents were made by the collaboration of not only researchers and medical professionals, but also many staff from the largest noncommercial broadcasting corporation in Japan, that is, with mass media communication experts. As a result, this collaboration might have made the television programs more attractive for the audience, and many subjects reported that they had seen the 1-minute spots and the highlight programs during the campaign. In addition, our programs were repeated many times, which should have increased the likelihood of people seeing them, remembering them, and also remembering how to act if someone experiences early symptoms of stroke.

In previous studies that focused on public education about knowledge of stroke symptoms, the effectiveness of campaigns was assessed according to the ability to name ≥2 early symptoms of stroke without being shown multiple-choice items.[6,12] However, patients with stroke are unable to choose their own symptom at the time of onset, so people should be aware of all the typical early symptoms of stroke. Accordingly, the present study assessed improvements in knowledge about early symptoms of stroke based on the proportion of respondents who correctly chose all 5 early symptoms from a list of 10 symptoms.

We did not find significant improvements in knowledge about early symptoms of stroke among men. The improvement only in women may be explained by the greater exposure to television programs associated with the campaign, as suggested by the higher audience rates in women than in men. Furthermore, in previous studies of Western populations, knowledge about early symptoms of stroke was found to be better in women than in men during periods both with and without educational campaign.[12,13] Our results demonstrated not only similar sex differences to these previous studies, but also sex differences in the effects of the television campaign in a controlled trial. These results raise the possibility that men may have less general interest about health information compared with women. Therefore, it may be important to provide men various occasions to watch educational programs; for example, to increase a total number of on-air times, especially around programs that men are likely to watch such as sports, news, and action movies.

There are several limitations in the present study. First, we only evaluated the improvement in knowledge about early symptoms of stroke by broadcasting campaign; therefore, further study is necessary to assess its effectiveness in actual behaviors of patients with stroke; for example, the number of patients with stroke calling an ambulance, time from symptom onset to hospital presentation, how soon bystanders called the emergency center after having noticed early symptoms, and numbers of patients able to undergo therapy with tissue-type plasminogen activator should be evaluated. A previous cross-sectional study indicated that the knowledge about stroke symptoms was not associated with the intent to call 911 for stroke.[14] A gap may exist between the improvements in knowledge and actual changes in patient behavior. A second limitation is the lack of information about the costs involved in the campaign. The television programs were

made by NHK Okayama as its own project. Researchers thus did not need to worry about the costs of content production and broadcasting. Third, this study did not include individuals <40 years, who may be a person identifying a stroke onset of his or her family members and accessing the emergency medical services system. In addition, it is also important to distribute information about stroke to children and adolescent by television programs they are watching. They would probably advise their parents even if parents are not too interested about health information. This should be assessed in future studies.

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Disclosures

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栃木県脳卒中啓発プロジェクト

― 栃木県における包括的脳卒中市民啓発とその評価

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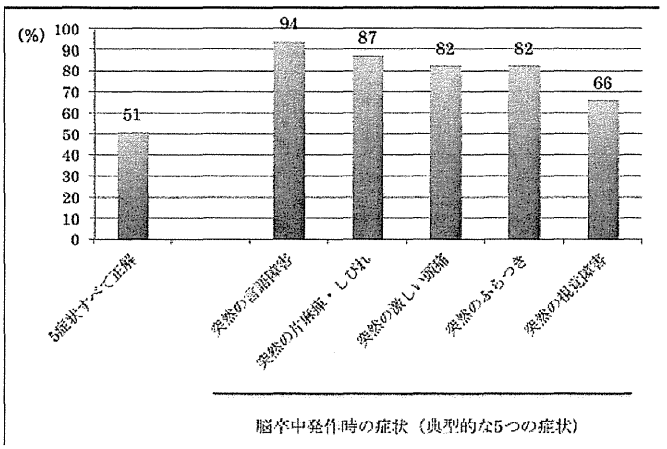
脳卒中はわが国の要介護状態の最大の原因であり、要介護度も高くなることが知られています。脳卒中による要介護数を減少させるためには、脳卒中の発症を予防すること、発症後の早期リハビリテーションなどで社会復帰を目指すことに加えて、脳卒中発作時にできるだけ早く専門医療機関を受診することが重要です。発症早期の専門医療機関受診のためには、市民の皆さんひとりひとりが脳卒中の発作を見逃さず、直ちに救急車を呼ぶことが大切になります。そのため、(公社) 日本脳卒中協会は、脳卒中になられた患者さんとご家族の支援や脳卒中予防の推進に加えて、脳卒中発症時の症状と適切な対処に関する知識の普及に長年にわたって取り組んできました。

市民の皆さんに脳卒中の症状について理解を深めていただく方法として、(公社) 日本脳卒中協会ではこれまでに厚生労働科学研究補助金事業「超急性期脳梗塞患者の救急搬送及び急性期病院受け入れ体制に関する実態調査研究」班 (代表者：木村和美) およびNHK岡山放送局、ACジャパンなど多くの組織や団体の協力を得て、リーフレット・小冊子などの頻回な配布やテレビによる1年間の継続した啓発活動が脳卒中症状に関する知識を向上させること、ACジャパンによる脳卒中啓発のCMを見ている人は脳卒中症状に関する知識が高いことなどを示してきました。またこれらの活動はいずれも科学的な手法で検証して来ました。

しかしながら、このような脳卒中に関する市民啓発をどの地域でも継続的に進めるためには、自治体や地域の医療・福祉機関、企業、教育機関等が中心となった総合的な取り組みが不可欠です。そのため (公社) 日本脳卒中協会では平成24年度に、厚生労働科学研究補助金事業「慢性期ハイリスク者、脳卒中および心疾患患者に適切な早期受診を促すための地域啓発研究」班 (代表者：宮本恵宏、以下地域啓発班) と共同で、脳卒中啓発を実施しようとする団体が無料で利用できる啓発動画を制作しました。そして現在は、これまでに制作した多くの啓発ツール (DVDやリーフレットなど) やACジャパンが制作した動画やポスター等を用いた地域啓発と、循環器病研究開発費「新しい脳卒中医療の開拓と均てん化のためのシステム構築に関する研究」班 (代表者：峰松一夫) から提供を受けたアニメやマンガ小冊子による中学生への脳卒中授業を中心とした、包括的な栃木県脳卒中啓発プロジェクトを実施しています。



図：栃木県民の脳卒中発作時症状に関する知識
(平成24年9月調査)

また啓発活動の実施に先立ち、脳卒中発作時の症状の理解と対応に関する知識調査を行いました。調査はRandom Digit Dialing法（ランダムに発生させた番号に電話して調査へのご協力をお願いする、社会調査でよく用いられる方法、以下RDD）により、同意が得られた40～74歳の市民の皆さんに対して実施されました。この調査の結果、脳卒中発作時の5つの典型的な症状のうち、「突然生じる言語障害」「突然生じる片側の麻痺やしびれ」「突然生じる激しい頭痛」「突然生じるふらつき・脱力感」はいずれも8割～9割強の方々が理解していることが示されました。しかしながら「突然生じる視覚

障害」を脳卒中発作の症状と知っている方はやや少なく、5つの典型的な症状すべてを正しく選択した方は全体の約半数のみでした。また、「脳卒中を疑ったとき、しばらく様子を見る」とした方が5%おられました。

今回の栃木県の脳卒中知識調査では、過去の数回の調査と同様に、脳卒中発作時の典型的な5つの症状すべてを理解している方は約半数にとどまること、比較的軽度の症状についての認識が低いことが示され、啓発によりこれらが向上するかどうかを検討することが必要だと考えられました。平成25年5月に栃木県下各地で開催される脳卒中市民講座が終了した後に同様の調査を行い、この8ヶ月にわたる包括的啓発活動の効果を評価する予定です。栃木県の取り組みで啓発効果が検証されれば、多くの都道府県で実施可能な脳卒中市民啓発のモデルとなると考えています。

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Impact of the number of on-scene emergency life-saving technicians and outcomes from out-of-hospital cardiac arrest in Osaka City☆

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ABSTRACT

Backgrounds: In Japan, ambulance staffing for cardiac arrest responses consists of a 3-person unit with at least one emergency life-saving technician (ELST). Recently, the number of ELSTs on ambulances has increased since it is believed that this improves the quality of on-scene care leading to better outcomes from out-of-hospital cardiac arrest (OHCA). The objective of this study was to evaluate the association between the number of on-scene ELSTs and OHCA outcome.
Methods: This was a prospective cohort study of all bystander-witnessed OHCA patients aged ≥18 years in Osaka City from January 2005 to December 2007 using on an Utstein-style database. The primary outcome measure was one-month survival with favorable neurological outcome defined as a cerebral performance category ≤2. Multivariable logistic regression model were used to assess the contribution of the number of on-scene ELSTs to the outcome after adjusting for confounders.
Results: Of the 2408 bystander-witnessed OHCA patients, one ELST group was present in 639 (26.5%), two ELST were present in 1357 (56.4%), and three ELST group in 412 (17.1%). The three ELST group had a significantly higher rate of one-month survival with favorable neurological outcome compared with the one ELST group (8.0% versus 4.5%, adjusted OR 2.26, 95% CI 1.27–4.04), while the two ELST group did not (5.4% versus 4.5%, adjusted OR 1.34, 95% CI 0.82–2.19).
Conclusions: Compared with the one on-scene ELST group, the three on-scene ELST group was associated with the improved one-month survival with favorable neurological outcome from OHCA in Osaka City.

1. Introduction

Sudden cardiac arrest (SCA) is one of the leading causes of death and an important public health problem in the industrialized world.[1,2] In Japan, approximately 60,000 out-of-hospital cardiac arrests (OHCAs) of cardiac origin occur every year, and this number has been steadily increasing.[3] Despite continuous improvements

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in the "chain of survival," survival from OHCA remains low.[1–4]

In Japan, the Emergency Medical Service (EMS) system response mostly consists of a single tiered ambulance system that is dispatched to the scene of all OHCA. Each ambulance is staffed with a 3-person unit including at least one emergency life-saving technician (ELST). ELST are trained to perform advanced airway management and may also administer adrenaline under on-line medial command.[5] The number of trained ESLTs has been steadily increasing in Japan,[5] which might improve the quality of care delivered on scene and lead to improved outcomes from OHCA. However, the benefits of having multiple higher trained providers on critical EMS calls for OHCA patients remain controversial.[6,7]

In 1998, the Osaka Municipal Fire Department launched a population-based registry of OHCA in Osaka City, a large urban community with approximately 2.7 million inhabitants. Using this database, we collected approximately 2400 bystander-witnessed OHCAs from January 1st, 2005 to December 31st, 2007. The aim of this study was to evaluate the association between the number of ELSTs on scene and outcomes from OHCA.

2. Methods

2.1. Study design, population, and setting

The present study was carried out within the Utstein Osaka Project, a prospective, population-based cohort study of all persons with OHCA treated by EMS personnel in Osaka prefecture, Japan. This study included all OHCA patients in Osaka City aged 18 years or older who were presumed to be of cardiac and non-cardiac origin, witnessed by bystanders, and transported to medical institutions from January 1, 2005 through December 31, 2007. Osaka City is the third largest city in Japan with a population of 2.7 million residents (2005) in an area of 222 km^2.[8] Cardiac arrest was defined as the cessation of cardiac mechanical activities as confirmed by the absence of signs of circulation.[9,10] An arrest was presumed to be of cardiac etiology unless it was caused by trauma, drowning, drug overdose, asphyxia, exsanguination, or by any other non-cardiac causes determined clinically by a physician in charge, working in collaboration with the EMS.

This study was approved by the Ethics Committees of the Kyoto University Graduate School of Medicine. The requirement to obtain individual informed consent for the review of patient outcome was waived by the Personal Information Protection Law and the National Research Ethics Guidelines of Japan.

2.2. The EMS system in Osaka City

The municipal EMS system is the same as in other areas of Osaka Prefecture, and has been described previously.[4,11,12] The EMS system is operated by the Osaka Municipal Fire Department and is activated by dialing 119 on the telephone. During the study period, there were 25 fire stations (60 ambulances) and a single dispatch center in Osaka City.[13] Life support is available there 24 h every day.

Each fire ambulance has three EMS personnel with at least one ELST, a highly-trained prehospital emergency care provider. ELSTs are authorized to use an automated external defibrillator, to insert an intravenous line, and to place advanced airway management devices for OHCA patients under on-line medical control direction. Specially trained ELSTs have been permitted to insert tracheal tubes since July 2004 and to administer intravenous epinephrine since July 2006. In Japan, EMS personnel are not permitted to terminate resuscitation in the field and all patients on whom resuscitation is attempted are transported to the hospital. Until September 2006, all EMS providers performed CPR according to the Japanese Guidelines based on the American Heart Association, European Resuscitation Council, and the International Liaison Committee on Resuscitation 2000 Guidelines using a 15:2 compression-to-ventilation ratio. After September 2006, they switched to a ratio of 30:2 based on the 2005 Guidelines.[14] Public-access defibrillation programs have been promoted in Japan since July 2004.[14]

2.3. ELST certification

There are two options to becoming certified as an ELST in Japan.[11] The first is through the educational system within the fire department itself. To become an Emergency Medical Technician (EMT), all fire department personnel are required to have received fundamental medical education in emergency care for 250 h through a training academy. After being actively engaged in pre-hospital setting as an EMT for more than 5 years or 2000 h, EMTs must pass the national examination of ELST after having received at least one additional year of medical education and training at the fire academy. The second way is through the education system in an accredited EMT school or college. To become an ELST, candidates must pass the national examination of ELST after receiving medical education and training in emergency care at the certified EMT school or college for at least two years. The cumulative number of ELSTs has increased gradually in Osaka City and reached to 508 in 2007 since the ELST system started in 1991.[13]

2.4. Data collection and processing

Data were prospectively collected using a data collection tool designed by the project steering committee. Included were all core data elements recommended in the Utstein style for OHCA,[9,10] including age, sex, etiology, first documented rhythm, resuscitation time-course, bystander-initiated CPR, location of arrest, advanced airway placement, adrenaline administration, year, field return of spontaneous circulation (ROSC), total ROSC, hospital admission, and one-month survival and neurological status at one month after the event as well as the number of on-scene ELSTs. Resuscitation time-course included a series of EMS-related times such as call, the initiation of CPR, departure at the scene, and hospital arrival. ROSC was defined as the restoration of a sustained spontaneous perfusing rhythm.[9,10] The data sheet was filled out by the EMS personnel in cooperation with the physicians in charge of the patient. It was then transferred to the Information Center for Emergency Medical Services of Osaka and reviewed by the investigators. If the information provided on the data sheet was unclear or incomplete, it was returned to the appropriate EMS personnel for completion.

2.5. Methods of measurement

All survivors were followed for up to one month after the event, and the neurological outcomes were determined by the physician responsible for the care of the patient. Neurological status was determined using the Cerebral Performance Category (CPC) scale: category 1, good cerebral performance; category 2, moderate cerebral disability; category 3, severe cerebral disability; category 4, coma or vegetative state; and category 5, death.[9,10] Neurologically favorable survival was defined as a CPC category 1 or 2.[9,10] The primary outcome measure was one-month survival with favorable neurological outcome. Secondary outcomes included field ROSC, total ROSC, hospital admission, and one-month survival.

2.6. Primary data analysis

Patient characteristics, EMS characteristics, and outcomes among bystander-witnessed OHCA patients were evaluated after grouping the EMS scene personnel based on the number of ELSTs

(One ELST plus two EMTs, two ELSTs and one EMT, or three ELSTs [no EMT]). Patient characteristics were compared using chi-square test for categorical variables and one-way analysis of variance for numerical variables. EMS characteristics such as procedures and care time intervals by EMS were tested with univariable regression models for categorical variables and linear tests for numerical variables. Multivariable logistic regression models were used to assess the contribution of the number of on-scene ELSTs to the outcomes referring to one ELST. Odds ratios (ORs) and their 95% confidence intervals (CIs) were calculated after adjusting for potential confounding factors that were biologically essential and considered to be associated with outcomes were included in the multivariable analysis. Those factors included age (for one year old increase), sex (male or female), etiology (presumed cardiac or non-cardiac), first documented rhythms (VF or others), location of arrest (public or not), bystander CPR (yes or no), advanced airway management (yes or no), epinephrine administration (yes or no), and the time interval from call to CPR by EMS (for one minute increase), and year (for one year increase). All statistical analyses were performed using SPSS statistical package ver16.0J (SPSS, Inc., Chicago, IL). All tests were 2-tailed, and P values of <0.05 were considered statistically significant

3. Results

3.1. Overview of OHCA patients in Osaka City

During these 3 years, a total of 6942 OHCA patients were registered (Fig. 1). Of them, 6849 were adults aged ≥18 years old, and 6461 were attempted resuscitation by EMS. A total of 2408 bystander-witnessed OHCA patients were eligible for our analyses excluding 487 patients witnessed by EMS and 3566 patients without witness. Among these patients, 639 (26.5%) received basic life support (BLS) or advanced life support (ALS) procedures by one ELST on the scene, 1357 (56.4%) two ELSTs, and 412 (17.1%) three ELSTs, respectively. The proportion of on-scene three ELSTs did not significantly increased during the study period.

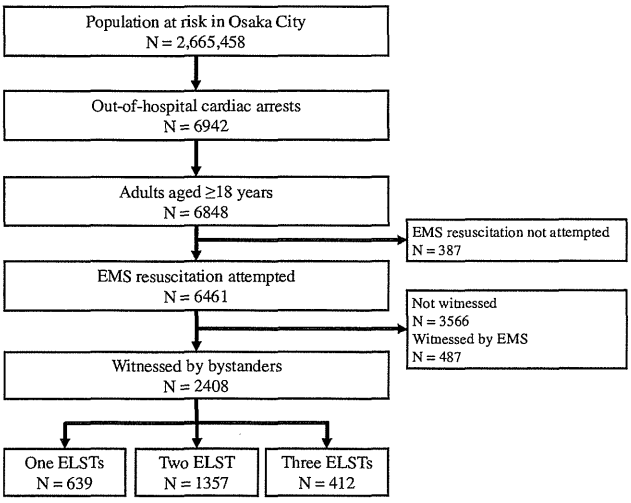

Fig. 1. Overview of out-of-hospital cardiac arrests with an abridged Utstein template from January 1, 2005 through December 31, 2007. EMS, emergency medical service; ELST, emergency life-saving technician.

3.2. Patient characteristics by the number of on-scene ELSTs

Table 1 shows the patient characteristics of bystander-witnessed OHCA by the number of on-scene ELSTs. Mean age and the proportion of male, public places, VF as first documented rhythm, and presumed cardiac etiology were similar between the three groups. The proportion of patients with bystander CPR was significantly different between the groups ($P=0.036$).

3.3. EMS characteristics by the number of on-scene ELSTs

EMS advanced interventions and activity times of bystander-witnessed OHCA by the number of on-scene ELSTs are noted in Table 2. The proportion of adrenaline administration (from 4.7% in the one ELST group to 14.1% in the three ELST group, P for trend <0.001) and advanced airway management (from 78.2% in the one ELST group to 83.5% in the three ELST group, P for trend $=0.003$) was significantly higher as the number of on-scene ELSTs increased. The EMS scene time also increased with the presence of more ELSTs (from 12.4 minutes in the one ELST group to 13.5 minutes in the three ELST group, P for trend $=0.001$) whereas the time interval from 119 call to CPR initiation by EMS remained the same.

3.4. Outcomes by the number of ELSTs

Table 3 shows the outcomes from bystander-witnessed OHCA by the number of on-scene ELSTs. The three ELST group had a significantly higher rate of one-month survival with favorable neurological outcome compared with the one ELST group (8.0% versus 4.5%, adjusted OR 2.26, 95% CI 1.27–4.04). However, the two ELST group did not (5.4% versus 4.5%, adjusted OR 1.34, 95% CI 0.82–2.19). However, increasing the number of on-scene ELSTs did not significantly improve field ROSC, total ROSC, hospital admission, and one month survival after OHCA.

3.5. Factors associated with favorable neurological outcome

In the multivariable analysis, factors associated with one-month survival with favorable neurological outcome are shown as a forest plot in Fig. 2. Younger age (adjusted OR for one year old increase 0.99, 95% CI 0.97–0.99), presumed cardiac etiology (adjusted OR 2.24, 95% CI 1.25–4.02), VF as first documented rhythm (adjusted

Table 1
Patient characteristics of bystander-witnessed out-of-hospital cardiac arrest by the number of ELSTs.

	The number of on-scene ELSTs			
	One ELST ($N=639$)	Two ELSTs ($N=1357$)	Three ELSTs ($N=412$)	P value
Age, year, mean (SD)	68.9 (17.4)	69.8 (16.8)	68.7 (17.2)	0.950
Men, n (%)	423 (66.2)	840 (61.9)	272 (66.0)	0.101
Cardiac etiology, n (%)	414 (64.8)	927 (68.3)	284 (68.9)	0.231
VF as first documented rhythm, n (%)[a]	109 (17.1)	227 (16.8)	70 (17.1)	0.981
Public location, n (%)	138 (21.6)	288 (21.2)	82 (19.9)	0.794
Bystander CPR, n (%)	214 (33.5)	428 (31.5)	158 (38.3)	0.036

ELST denotes emergency life-saving technician; VF, ventricular fibrillation; CPR, cardiopulmonary resuscitation; SD, standard deviation.
[a] Data on VF were missing for 14 (0.6%) patinets.

Table 2
EMS characteristics of bystander-witnessed out-of-hospital cardiac arrest by the number of ELSTs.

	The number of on-scene ELSTs			
	One ELST (N=639)	Two ELSTs (N=1357)	Three ELSTs (N=412)	P for trend
Adrenaline, n (%)	30 (4.7)	136 (10.0)	58 (14.1)	<0.001
Advanced airway, n (%)	500 (78.2)	1099 (81.0)	44 (83.5)	0.003
EMS care interval, min, mean (SD)				
Call to EMS CPR start	8.3 (3.4)	8.0 (3.0)	8.1 (3.4)	0.171
EMS scene time	12.4 (5.1)	12.9 (5.2)	13.5 (5.5)	0.001

ELST denotes emergency life-saving technician; EMS, emergency medical service; CPR, cardiopulmonary resuscitation; SD, standard deviation.

Table 3
Outcomes from bystander-witnessed out-of-hospital cardiac arrest by the number of ELSTs.

		The number of on-scene ELSTs		
	Total (N=2408)	One ELST (N=639)	Two ELSTs (N=1357)	Three ELSTs (N=412)
Field ROSC, n (%)	318 (13.2)	75 (11.7)	175 (12.9)	68 (16.5)
Adjusted OR (95% CI)		Reference	1.07 (0.78–1.45)	1.41 (0.96–2.07)
Total ROSC, n (%)	1030 (42.8)	265 (41.5)	77 (42.5)	188 (45.6)
Adjusted OR (95% CI)		Reference	1.03 (0.84–1.25)	1.17 (0.90–1.51)
Hospital admission, n (%)	57 (35.6)	212 (33.2)	488 (36.0)	157 (38.1)
Adjusted OR (95% CI)		Reference	1.14 (0.93–1.40)	1.24 (0.95–1.62)
One-month survival, n (%)	281 (11.7)	69 (10.8)	160 (11.8)	52 (12.6)
Adjusted OR (95% CI)		Reference	1.15 (0.84–1.59)	1.24 (0.82–1.87)
CPC 1 or 2, n (%)	135 (5.6)	29 (4.5)	73 (5.4)	33 (8.0)
Adjusted OR (95% CI)		Reference	1.34 (0.82–2.19)	2.26 (1.27–4.04)

ELST, denotes emergency life-saving technician; ROSC, return of spontaneous circulation; CPC, cerebral performance category; OR, odds ratio; CI, confidence interval. ORs were calculated after adjusting for age, gender, etiology, first documented rhythm, location, bystander CPR, advanced airway management, epinephrine admistration, call to CPR time by EMS, and year.

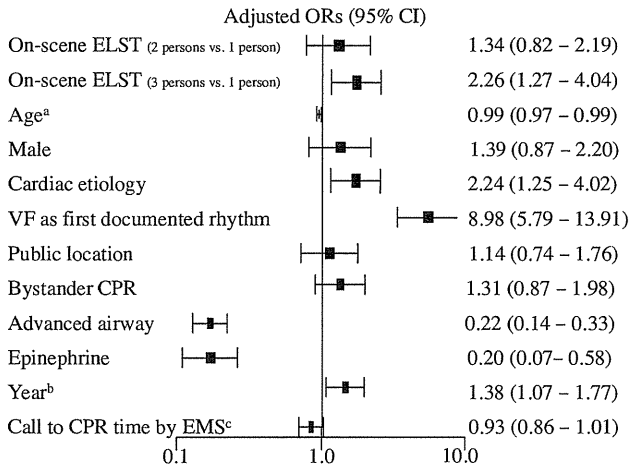

Fig. 2. Multivariable-adjusted odds ratios for one-month neurologically favorable survival. OR, odds ratio; CI, confidence interval; VF, ventricular fibrillation; CPR, cardiopulmonary resuscitation; ELST, emergency life-saving technician; EMS, emergency medical service. [a]OR for one year old increase, [b]OR for one year increase, [c]OR for one minute increase.

OR 8.98, 95% CI 5.79–13.91), and year (adjusted OR for one year increase 1.38, 95% CI 1.07–1.77) were also associated with a better neurological outcome. Advanced airway management (adjusted OR 0.22, 95% CI 0.14–0.33) and epinephrine administration (adjusted OR 0.20, 95% CI 0.07–0.58) were associated with a worse outcome.

4. Discussion

From this large, prospective registry in Osaka City, we demonstrated that the three on-scene ELST group was associated with the improved one-month survival with favorable neurological outcome from OHCA compared with the one on-scene ELST group. Since ELST program started in 1991, the Fire and Disaster Management Agency of Japan has recommended that each ambulance be staffed with a 3-person unit including at least one ELST, The cumulative number of certified ELSTs in Japan was reported to be 21,268 in 2010.[5] However, the impact of increasing the number of on-scene ELSTs has been insufficiently investigated to date. The results from this study will provide additional useful information on the design and structure of EMS systems in Japan and elsewhere.

Why did on-scene participation of three ELSTs contribute to improving favorable neurological outcome from OHCA? Although the proportion of advanced airway management and adrenaline administration increased with increasing the number of on-scene ELSTs in this target area, these treatment factors did not contribute to improving one-month survival with favorable neurological outcome from OHCA in the multivariable analysis. Far from it, they seemed to be associated with a worse outcome like some previous observational studies suggested.[15,16] However, we consider that there should be an inversion phenomenon of cause-and-effect and it would be difficult to assess the effect of ALS measures in this observational study, because EMS personnel in Japan could provide advanced life support measures only for OHCA patients who did not get ROSC by basic life support such as chest compressions and defibrillations. The adjustment in the multivariable analysis for epinephrine administration and use of advanced airways procedures which were used more extensively when there were more trained EMS personnel might be questioned, but the analysis without these variables also produced the same conclusions. Previous observational studies showed that the procedural experience of paramedics was associated with the improved outcome after prehospital cardiac arrests.[17–19] Of note, that paper also showed no effect of the years of treatment decision making on outcomes from cardiac arrest.[19] Because ELSTs in Japan are well-trained and have accumulated their on-scene experience to obtain the certification as described in the Methods, on-scene participation of the multiple ELSTs with more clinical experience might lead to better CPR quality and improve team dynamics and crew resource management, and resulted in better outcomes from OHCA.

While favorable neurological outcome significantly differed by the number of ELSTs, there were no significant associations between the ELST groups and other outcomes, although all adjusted ORs were greater than one. Our previous report suggesting the effectiveness of CPR by bystanders also showed significant difference only in neurological outcome while there were no difference in other outcomes.[20] Different from advanced treatments like epinephrine admistration,[12,15] the effectiveness of CPR or the CPR quality might tend to be greater in neurological function rather than other outcomes, and this discrepancy also might suggest that on-scene participation of the multiple ELSTs contribute better neurological outcomes by improving CPR quality. In addition, the improvement in favorable neurological outcome during the study period could be partially explained by the changes of the CPR guideline,[21] which might contribute to improve the CPR quality by EMS. Unfortunately, we did not have detailed information on CPR quality measures or team dynamics between ELSTs. We are now prospectively collecting these data in the designated target area and hope to address this issue in a future study.

Other published observational studies have not been able to demonstrate the benefits from having additional advanced trained providers such as paramedics on scene on survival or resuscitation process measures.[6,7] One study demonstrated decreased survival rates as the number of on-scene paramedics increased,[6] and suggested that the CPR quality was more important than the number of paramedics themselves. If so, both this study and our study, which look like different results, might suggest the same thing (i.e., importance of improving the CPR quality). In addition, there are several reasons why these findings are different from ours. This study used an OHCA data registry from a two tiered EMS system. Osaka has a single tier EMS system and is one of the most advanced areas of prehospital cares and has a considerable high rate of favorable neurological outcome.[4] These differences in EMS system might affect the effect of the number of EMS personnel. Although a previous report showed that two tiered system are more effective that single tiered systems with regards to improved survival from OHCA,[22] such systems might reduce the effectiveness of the having a higher number of trained personnel on scene.

Furthermore, differences in the prehospital emergency systems between Japan and western countries might also have affected the differences in the effects seen from having a higher number of more trained providers on scene. Unlike paramedics from western countries, highly-trained ELSTs in Japan are only permitted to perform ALS procedures during resuscitation efforts.[11,23] In addition, EMS providers were not permitted to terminate resuscitation in the field.[3,24] These differences in the training levels of ELST vs. paramedics from western countries require further study.

Importantly, the number of ELSTs needed within EMS in Japan deserves discussion, even if the increased number of on-scene ELSTs contributed to improving the outcome from OHCA in this study. Potential disadvantages of having more ELSTs on the scene include decreased procedural experience per ELST. It is also very expensive to train and maintain the skills of EMS personnel[11] and the cost-effectiveness of any EMS system structure changes should be considered as well. Clearly, more studies are needed to assess the association between the increased number of on-scene ELSTs, the skills performed and the OHCA outcome to better understand how to best deploy the most efficient and cost-effective emergency medical system.

This study has some inherent limitations, however. First, we did not obtain data on the ELST certification basis (college training vs. practice pathway) or experience level, both of which could have an influence on the outcomes. In addition, we were not able to classify the exact ELST level (additional certification is required for endotracheal intubation or/and adrenaline administration). Secondly, CPR quality measures which have been associated with outcomes from OHCA (compression rate, compression depth, CPR fraction, peri-shock pauses and ventilation rate) were not available for analysis in this study.[25,26] Third, our data does not address potential impact of post-resuscitation care within hospitals (hemodynamic support, induced hypothermia, and coronary interventional therapies).[27] Fourth, CPC scores might be biased due to physician's invested interest in the patient's outcome. Finally, this was not a randomized controlled trial and although we adjusted for Utstein confounding variables in the multivariable analysis, other unknown confounding factors might exist which may have affected our findings.

5. Conclusions

Compared with the one on-scene ELST group, the three on-scene ELST group was associated with the improved one-month survival with favorable neurological outcome from OHCA in Osaka City. Additional studies are required to further understand these findings.

Conflict of interest

There are no conflicts of interest to declare.

Role of funding source

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Stroke Education Program of Act FAST for Junior High School Students and Their Parents

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Background: We produced a stroke education program using the FAST (facial droop, arm weakness, speech disturbance, time to call an ambulance) mnemonic. *Aims:* The aim of this study is to examine efficacy of our education program for junior high school students and their parents. *Methods:* One hundred ninety students of 3 junior high schools (aged 12-13 years) and their parents were enrolled. Students received a 45-minute lesson of stroke enlightenment using the FAST mnemonic. Enlightenment items, such as a magnet poster, were distributed. Parents were educated indirectly from their child. Surveys of stroke knowledge were examined at baseline, immediately after the lesson, and at 3 months after the lesson. *Results:* For the students, correct answers at 3 months were significantly higher than those at baseline in questions of facial palsy (98% versus 33%), speech disturbance (98% versus 54%), numbness on one side (64% versus 42%), weakness on one side (80% versus 51%), calling an ambulance (88% versus 60%), alcohol drinking (85% versus 65%), smoking (70% versus 43%), dyslipidemia (58% versus 46%), hyperglycemia (59% versus 48%), and obesity (47% versus 23%). At 3 months, the parents answered more correctly questions of facial palsy (93% versus 66%), calling an ambulance (95% versus 88%), and alcohol drinking (65% versus 51%) than at baseline. At 3 months, 96% of students and 78% of parents answered the FAST mnemonic correctly. *Conclusions:* Our stroke education program improved stroke knowledge, especially the FAST message, for junior high school students and their parents. **Key Words:** School-based intervention—stroke enlightenment—stroke knowledge—emergent medical service—prehospital delay.

Introduction

Stroke is a major cause of disability and a major cause of death worldwide. Shortening the time from the onset of stroke symptoms to hospital arrival is important for effective stroke treatment because the early administration of recombinant tissue-type plasminogen activator is beneficial for stroke outcome.[1,2] Both a reduction in the risk of stroke and a decrease in prehospital delay after the onset of stroke are considered to depend on the level of stroke knowledge in the general population.[3] Education program and the target population for education are essential for effective stroke enlightenment. Retained knowledge of stroke awareness results in appropriate

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action of calling emergent medical services (EMS) on stroke onset. Although there are several reports of public education for stroke enlightenment,[4-9] there are only a few studies in children.[10-12] School-based interventions of stroke enlightenment are beneficial for students and a promising means for delivering stroke message to their parents or grandparents.[10-12] The methods used to educate children for stroke enlightenment would be different depending on age, ethnicity, and socioeconomic status of their parents.

Aims

The aim of this study was to examine the efficacy of our stroke education program for junior high school students and their parents.

Methods

Stroke Enlightenment Items

For enlightenment of stroke sign and symptoms, we used "FAST" derived from the Cincinnati Prehospital Stroke Scale, where F is face numbness or weakness, A is arm numbness or weakness, and S is slurred speech or difficulty speaking or understanding.[5,13] We produced a poster measuring 600 × 400 mm, a magnet poster measuring 150 × 105 mm, and a paper file measuring 310 × 220 mm that were printed with the FAST message (Fig 1). School items such as a pen and sticky note with the FAST mnemonic were also produced.

Subjects and Study Design

This study was exempted from approval by the institutional review board based on our domestic guideline because of the use of only an anonymized and untraceable data set. We enrolled 190 students in 6 classes of the first grade of 3 private junior high schools (aged 12-13 years) and their parents. We conducted stroke lessons between October 2010 and March 2011. Students received a 45-minute lesson performed by stroke neurologists. The lesson was composed of a lecture with slide show and a short role-play with students. In the lecture, students were taught stroke risk factors, stroke signs and symptoms, and appropriate urgent responses when they suspected stroke by using FAST mnemonic. Students could understand the FAST mnemonic in English because they had learned the word FAST in English class. In the short role-play, the neurologist acted as an old man just suffering from stroke and students performed in accordance with the FAST mnemonic. At the close of the lesson, we distributed the pen, paper file, magnet posters, sticky notes printed with the FAST message, and papers printed with the lecture slide show to each student. We did not conduct any stroke lessons for the students' parents. Instead, we asked the students to talk about stroke with their parents while showing them the images of the slide show and to place the magnet poster on the kitchen refrigerator. A FAST mnemonic poster was displayed in each classroom for 3 months after the stroke lesson.

For the assessments, multiple-choice and closed-type questionnaires on stroke knowledge (including a total of 7 items for risk factors, 6 items for stroke signs and symptoms, and 1 item for appropriate urgent responses) were filled out by the students at baseline, immediately after the lesson, and at 3 months after the lesson. All data were collected without personal identifiers. For questionnaires at the baseline, questionnaires were distributed to the students within 7 days before the day of the stroke lesson. Students also took the same questionnaires to their parents on the day of the stroke lesson and at 3 months after the lesson. Parents filled out questionnaires before, immediately, and 3 months after talking about stroke with their children. Questionnaires filled out by parents were gathered through their child who took them to their children at school.

Statistical analyses were performed using JMP7.0 (SAS Institute, Inc., Cary, NC). Data are presented as frequencies (%). Data were compared among 3 groups with Fisher exact test: baseline, immediately after the lesson, and 3 months after the lesson. The proportion of selecting "calling EMS" on the identification of stroke signs or symptoms was also assessed with Fisher exact test. A value of P less than .05 was considered to indicate a significant difference.

Result

Assessment for Students

Because a few students were absent from school, the numbers of questionnaires collected immediately and at 3 months after the lesson were 189 (99%) and 187 (98%), respectively. Immediately after the lesson, the frequencies of correct answers for all questions were significantly higher than those at baseline (Table 1). At 3 months after the lesson, the number of students with correct answers of facial palsy (98% versus 33%), speech disturbance (98% versus 54%), numbness on 1 side of body (64% versus 42%), and weakness on 1 side of body (80% versus 51%) were significantly improved. However, severe headache (26% versus 55%) and vision loss (5% versus 17%) were significantly decreased compared with those at baseline. More students answered correctly about calling EMS for stroke (88% versus 60%) and risk factors except hypertension or arrhythmia at 3 months after the lesson compared with those at baseline. The 96% of students who understood the meaning of FAST mnemonic at 3 months after the lesson was similar to that immediately after the lesson.

Assessment for Student's Parents

A total of 183 (96%) questionnaires were filled out by students' parents at baseline, with 155 (82%) immediately,

Figure 1. *FAST message poster for stroke warning signs. FAST represents "F," facial droop; "A," arm weakness; "S, speech disturbance; and "T," time to call an ambulance. The FAST message means that if you recognize one of these symptoms, check the onset time and call an ambulance. These messages are written in Japanese.*

and 175 (92%) at 3 months after the lesson. Parents immediately after the lesson, who chose facial palsy (94% versus 66%), vision loss (46% versus 31%), and speech disturbance (97% versus 91%) as stroke symptoms, 7 correct answers except hypertension as risk factors, and a correct urgent response (97% versus 88%), were significantly higher than those at the baseline (Table 2). At 3 months after the lesson, the number of parents with correct answers of stroke risk factors except alcohol drinking decreased to the same level as those at baseline. However, the correct answer rate of facial palsy (93% versus 66%) and calling EMS (95% versus 88%) persisted as similar to that immediately after the lesson. The 89% of parents who understood correctly the FAST mnemonic immediately after the lesson was similar to that at 3 months after the lesson.

Discussion

Our results showed that our stroke education program by using our homemade items for junior high school students improved their stroke knowledge, especially for the FAST message. Understanding of the FAST message was

Table 1. *The percentages of correct answers to questions about stroke over all 3 surveys for students*

Questions	Baseline (n = 190), %	Immediate after the lesson (n = 189), %	P*	3 months after the lesson (n = 187), %	P*
1. Stroke signs and symptoms					
Headache	55	66	.0359	26	<.0001
Facial palsy	33	98	<.0001	98	<.0001
Vision loss	17	41	<.0001	5	.0003
Speech disturbance	54	97	<.0001	98	<.0001
Numbness on 1 side of the body	42	82	<.0001	64	<.0001
Weakness on 1 side of the body	51	95	<.0001	80	<.0001
2. Adequate action when stroke onset					
Call an ambulance	60	96	<.0001	88	<.0001
3. Stroke risk factors					
Alcohol drinking	65	91	<.0001	85	<.0001
Smoking	43	89	<.0001	70	<.0001
Hypertension	73	97	<.0001	81	.0509
Dyslipidemia	46	85	<.0001	58	.0233
Hyperglycemia	48	81	<.0001	59	.0498
Obesity	23	72	<.0001	47	<.0001
Arrhythmia	39	69	<.0001	43	ns
4. FAST mnemonic					
F = face		100	NA	98	NA
A = arm		99	NA	99	NA
S = speech		100	NA	98	NA
T = time		99	NA	99	NA
All corrected		98	NA	96	NA

Abbreviations: NA, not applicable; ns, nonsignificant.
*Fisher exact test, compared with baseline.

also observed in the students' parents who instructed in stroke enlightenment by their children.

Williams and Noble[10] reported that incorporating cultural elements such as hip-hop music improved retention of stroke knowledge among elementary school children. They also demonstrated the possibility of child-mediated stroke communication from the results of questionnaires for the parents at 1 week after the intervention for the children.[12] Morgenstern et al[11] showed that their stroke enlightenment project, intended for middle school children and their parents/guardians, was beneficial for the children but not for their parents/guardians. In our study, a high rate of correct answers, especially for FAST message, was observed not only immediately but also 3 months after the stroke lesson in students and their parents. The stroke lesson, including the short role-play, would impress the FAST message on students. In addition, our homemade enlightenment items, such as the poster in the classroom, the magnet poster on the refrigerator at home, and stationary (paper file, pen, sticky note with the FAST mnemonic) might fix the FAST message in their minds. On the other hand, stroke symptoms other than FAST, such as severe headache or vision loss, were not recalled by the students after the stroke lesson. Therefore, our items of stroke enlightenment need to be improved for stroke symptoms not involved in the FAST mnemonic and stroke risk factors.

Although our education program was effective in keeping the FAST message in the mind of both students and their parents, it may be difficult to act promptly in calling EMS on the warning signs of stroke in future. Addo et al[14] reported that significant delays in seeking care after stroke still occur after a campaign to promote public awareness of stroke. Fussman et al[15] indicated a lack of association between stroke symptom knowledge and the intent to call EMS in the population-based survey. It would be necessary to repeat education program for fixing stroke knowledge during the junior high school period and to promote motivation for calling EMS by recognition that negative outcomes can be diminished by early awareness as previously indicated.[16] Moreover, not only stroke knowledge but also the presence of bystanders at stroke onset is essential for early arrival at hospital.[17,18] Our school-based stroke education program anticipates that the students would, at some time, play the role of bystander.

There are several limitations to our study. First, our study is not a randomized controlled study. It is difficult to maintain regular lectures of stroke enlightenment of intervention without leakage of the FAST mnemonic to non-intervention classes in the same school during the 3 months of the study period. Although the sample size was not large in this single-arm study, improvement of stroke knowledge was confirmed after our stroke

Table 2. *The percentages of correct answers to questions about stroke over all 3 surveys for parents*

Questions	Baseline (n = 183), %	Immediate after the lesson (n = 155), %	P*	3 months after the lesson (n = 175), %	P*
1. Stroke signs and symptoms					
Headache	83	72	.0128	67	.0006
Facial palsy	66	94	<.0001	93	<.0001
Vision loss	31	46	.0069	25	ns
Speech disturbance	91	97	.0122	95	ns
Numbness on 1 side of the body	75	77	ns	78	ns
Weakness on 1 side of the body	81	86	ns	87	ns
2. Adequate action when stroke onset					
Call an ambulance	88	97	.004	95	.0239
3. Stroke risk factors					
Alcohol drinking	51	75	<.0001	65	.0102
Smoking	73	86	.0049	79	ns
Hypertension	92	96	ns	93	ns
Dyslipidemia	80	91	.0057	77	ns
Hyperglycemia	49	67	.0009	49	ns
Obesity	56	68	.0249	54	ns
Arrhythmia	30	52	<.0001	31	ns
4. FAST mnemonic					
F = face		99	NA	90	NA
A = arm		94	NA	86	NA
S = speech		97	NA	93	NA
T = time		96	NA	86	NA
All corrected		89	NA	78	NA

Abbreviations: NA, not applicable; ns, nonsignificant.
*Fisher exact test, compared with baseline.

education program by the high proportion of follow-up examinations performed by either students or their parents. Second, the junior high school for interventions in the present study were conducted at private schools, and the parents of these students would have higher levels of education and upper socioeconomic status that might associate with the higher level of stroke knowledge at baseline as indicated previously.[6] Further examinations using randomized controlled studies that include several public schools with and without educational intervention will be needed. Third, this is a cross-sectional study, and behavioral change of calling EMS at awareness of stroke was not examined. Time monitoring of prehospital delay in the stroke centers within the area of the intervention of stroke education would be expected. Fourth, the assessments of stroke knowledge were examined by multiple-choice and closed-type questionnaires, possibly associated with an overestimate of stroke knowledge compared with open-ended questions. Finally, this study program requires lessons that are given by medical doctors. It would be necessary to require less assistance to spread the stroke enlightenment widely.

In summary, school-based interventions with our homemade items of stroke enlightenment are beneficial for junior high school students and a promising means for delivering the stroke message to their parents. Stroke enlightenment for the youth would promote a healthy life from a younger age, resulting in the primary prevention of cardiovascular disease in the future.

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