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Effects of a school-based stroke education program on stroke-related knowledge and behaviour modification—school class based intervention study for elementary school students and parental guardians in a Japanese rural area

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ABSTRACT

Objectives This study aimed to determine the effect of a stroke education programme on elementary school students and their parental guardians in a rural area in Japan that has high stroke mortality.

Design School class based intervention study.

Setting Eleven public elementary schools in Tochigi Prefecture, Japan.

Participants 268 students aged 11–12 years and 267 parental guardians.

Interventions Students received lessons about stroke featuring animated cartoons and were instructed to communicate their knowledge about stroke to their parental guardians using material (comic books) distributed in the lessons. Stroke knowledge (symptoms, risk factors and attitude towards stroke) and behavioural change for risk factors were assessed at baseline, immediately after the programme and at 3 months. We also evaluated behavioural change for risk factors among parental guardians.

Results The percentage of students with all correct answers for stroke symptoms, risk factors and the recommended response to stroke was significantly increased at 3 months P<0.001). We observed a significant increase in the percentage of guardians who chose all correct symptoms (P<0.001: 61.0% vs 85.4%) and risk factors (P<0.001: 41.2% vs 59.9%) at 3 months compared with baseline. The percentage of parental guardians with a high behavioural response to improving risk factors was significantly increased at 3 months compared with baseline (P<0.001).

Conclusions In a rural population with high stroke mortality, stroke education can improve knowledge about stroke in elementary school students and their parental guardians.

Strengths and limitations of this study

- Little has been reported on stroke knowledge at 3 months after lesson among elementary students and parental guardians in a rural area with high stroke mortality.
- This is the first report on the effect of an education programme about stroke on behavioural modification among parental guardians.
- Our research included a relatively small sample size; we were not able to set a control group because our lessons were performed as part of compulsory education.

Ethics and dissemination We conducted the intervention as a part of compulsory education; this study was not a clinical trial. This study was approved by the Ethics Committee of the National Cerebral and Cardiovascular Center (M27-026).

INTRODUCTION

Stroke has a high burden of medical costs for lifestyle disease, and it's one of the main causes of disability and death in Japan.[1–3] A shorter time between stroke onset and hospital arrival is associated with favourable outcomes, especially since the advent of thrombolytic treatment with tissue-type plasminogen activator (t-PA) for cerebral infarction.[4 5] Previous studies indicated that t-PA treatment within 4.5 hours of stroke onset dramatically improved acute mortality and functional outcomes.[6 7] However, substantial

delays in t-PA treatment are common, with the main reason being lack of knowledge about stroke symptoms.[8]

Strategies for effective community education about stroke in Japan include the distribution of leaflets, lectures and television programmes.[9–11] Stroke education for children at school may expand community knowledge about stroke because children are expected to share this knowledge with their families. Previous studies indicated that early stroke education improved knowledge about stroke among junior high school students.[12–15] However, most studies were performed in urban settings such as Osaka, a Japanese prefecture with low stroke mortality; few studies have been carried out in elementary schools in high-risk rural areas.[16–18] In Tochigi (a high-risk rural area), the stroke mortality rate in 2010 was 62.8/100 000 population for men and 35.5/100 000 population for women. In contrast, the rate was 43.9/100 000 population for men and 21.5/100 000 population for women in Osaka (urban area) and 49.2/100 000 population for men and 25.8/100 000 population for women in Tokyo (urban area) in 2010.[19]

Some previous school-based studies focused on improving stroke knowledge, but few have focused on the effect of improved stroke knowledge on healthy behaviour.[20–22] This study aimed to clarify the effectiveness of stroke education about early symptoms and risk factors on elementary school students and their parental guardians in Tochigi Prefecture, an area with one of the highest stroke mortality rates in Japan.

METHODS

Study population

This study was performed as a part of the Tochigi stroke education project,[23] a supervised public education campaign on stroke in Tochigi Prefecture. Tochigi has 1 974 255 residents, an area of 6409 km^2 and a population density of 308.2 people/km^2.[24–26] Compared with Tokyo (population density 6168.1/km^2) and Osaka (population density 4639.9/km^2), which are Japan's most urbanised areas, Tochigi is a rural area.[25] Tochigi Prefecture has a high age-adjusted stroke mortality rate. In 2012, the Tochigi Prefecture government started a stroke education project for all residents living in Tochigi Prefecture.[23] The prefectural office appointed eight local municipalities as intensive education areas. Participants in our study were 279 sixth grade students (aged 11–12 years) from 11 public elementary schools in these eight municipalities (total population: 628 174 people) and their parental guardians.[24] We provided nine lessons: one for each municipality and a joint lesson for three neighbouring small schools.

Stroke education programme

Before starting the lessons, two instructors from Keio University (KK, public health nurse; SK, educational expert) visited the National Cerebral and Cardiovascular Center to learn about educational tools and lecturing methods from stroke neurologists engaged in delivering lessons at elementary schools in Osaka. Next, they visited Dokkyo Medical University and presented about these methods to other instructors.

Participating students received a 45 min lesson about stroke delivered by our adjunct instructors (present authors). Eight adjunct instructors visited the elementary schools: three stroke neurologists, two public health physicians, one public health nurse, one management dietitian and one educational expert. Each instructor conducted one lesson, except for the educational expert who taught two lessons.

First, students were instructed about risk factors, symptoms and signs of stroke (20 min). Second, students watched an animated cartoon and reviewed the stroke signs using the FAST mnemonic (Facial numbness, Arm or leg numbness or weakness, difficulty in Speaking or understanding and Time to call an ambulance) (10 min) using manga (comic books). These materials have been previously described elsewhere.[17] After the lesson, students were asked to use the manga to instruct their parental guardians. Participating parental guardians were asked to complete a questionnaire about stroke knowledge.

Students and parental guardians completed a questionnaire to assess learning about stroke at baseline (before the lesson; BL), immediately after the lesson (IL) and at 3 months after the lesson (3 Mo). Questionnaires were disseminated to all students and parental guardians (279 pairs). In total, 268 students submitted completed questionnaires (response rate 96.1%). No student refused to participate, but some students were lost to follow-up because of illness-related absence from school (eg, common cold) on the day of the lecture. Eleven of the 279 parental guardians did not return completed questionnaires for any time point.

Assessment

The main outcomes were percentage of correct answers (stroke signs, symptoms and risk factors (multiple choice), attitude towards stroke and behaviour regarding risk factors (only parental guardians)). Participants were assessed as to whether they correctly checked each item and selected all correct answers (full points).

The questionnaire on stroke contained closed questions, including:

- Stroke signs and symptoms (three of seven items were correct)
  - Correct: facial weakness in one side/speech disturbance/numbness in one side of the body
  - Incorrect: flatus/fever/stomachache/stiff shoulders
- Risk factors
  - Correct: hypertension/high cholesterol/smoking/heavy drinking
  - Incorrect: back pain/faecal impaction/affluence
- Attitude towards stroke (one of four items was correct)
  - Take them to visit the hospital by taxi or private car
  - Take them to visit family doctor
  - Call an ambulance

  - Lie down to rest
- Attitude towards risk factors for stroke (only parental guardians)
  - Doing nothing in particular
  - Intend to change behaviour but not yet started
  - Engaged in lifestyle modification (uncontrolled) and medical treatment
  - Controlled lifestyle modification and medical treatment.

We also collected parental guardians' basic information, including age, relationship to the student and whether the family contained medical staff.

Statistical analysis

Statistical analysis was performed using R software (V.3.3.1). We compared stroke knowledge (signs, risk factors and attitude towards stroke) and behavioural change at baseline, immediately after the lesson and at 3 months. The McNemar test and binomial tests using Bonferroni correction were used. P values <0.05 were considered statistically significant.

As this study was performed as part of the Tochigi stroke education project,[23] the stroke education lessons were performed as official elementary school classes. The main study protocol on stroke education for elementary school students conformed to the Declaration of Helsinki. Ethical approval was also granted for data analysis and publication of our manuscript.

RESULTS

Change in students' knowledge of stroke

In total, 268 students were assessed after excluding those who did not complete the questionnaire and those with missing responses. The percentage of correct answers for each stroke sign increased significantly immediately after lessons and at 3 months compared with baseline (table 1). The number of students who chose all correct answers (full points) for three stroke signs increased significantly after the lesson (BL, 43.3%; IL, 95.9%; 3 Mo, 91.0%).

The percentage of students who answered that they would call an ambulance on recognition of stroke signs increased after the lesson (BL, 73.9% vs IL, 96.6%; P<0.001), although this decreased at 3 months (to 92.9%; P=0.038). The percentage of correct answers for each risk factor increased significantly immediately after the lesson and at 3 months. The number of students who chose all correct answers for the four risk factors increased significantly after the lesson (BL, 28.0% vs IL, 94.8%; P<0.001). However, this decreased at 3 months (to 73.5%; P<0.001).

Change in parental guardians' knowledge and behaviour towards stroke

In total, 268 parental guardians submitted questionnaires. We assessed 267 of these questionnaires after excluding one that had been completed by a student. Of the 267 parental guardians, 82.8% (n=221) were mothers and 10.4% (n=28) were medical staff. The percentage of responses correctly identifying facial weakness on one side as a stroke symptom increased after the lesson (table 2). The number of parental guardians who chose all correct answers for the three stroke signs also increased after the lesson (BL, 61.0%; IL, 88.8%; 3 Mo, 85.4%), as did the percentage of parental guardians who indicated that they would call an ambulance (BL, 81.6% vs IL, 94.7%; P<0.001). However, this percentage did not decrease significantly at 3 months after the lesson (93.3%). The percentage of parental guardians who selected smoking and heavy drinking as risk factors increased significantly immediately after the lesson, although this decreased at 3 months. In addition, parental guardians who chose all correct answers for the four risk factors increased after the lesson (BL, 41.2% vs IL, 73.8%; P<0.001) and decreased significantly at 3 months (IL, 73.8% vs 3 Mo, 59.9%; P<0.001).

Changes in behavioural responses for risk factors among parental guardians are shown in table 3. The percentage of parental guardians who answered 'controlled lifestyle modification and medical treatment' at 3 months was significantly increased compared with baseline (BL, 15.7% vs 3 Mo, 20.2%).

DISCUSSION

In a prefecture in Japan with high stroke mortality, elementary school students and their parental guardians showed improved knowledge of stroke immediately after a stroke education lesson provided by adjunct instructors. Furthermore, they retained the knowledge at 3 months after the lesson. In particular, this programme had a significant effect on participants' understanding of stroke symptoms, and they were able to recall the FAST mnemonic that was emphasised during the lesson. These results were similar to those reported by previous studies in junior high[11–15] and elementary schools.[16 17]

Previous studies in Osaka (the second largest urban area in Japan) reported that students improved their knowledge of stroke signs during stroke education and remembered the FAST message after education.[11 12 15] There were regional differences in mortality and medical environment between those studies and the present study. The crude stroke mortality rate in Tochigi Prefecture was about two times higher than that in Osaka Prefecture, where stroke education was delivered to junior high school students.[16 17] Tochigi Prefecture also has a high age-adjusted mortality rate (about 1.5 times higher than that in Osaka). Therefore, general interest about stroke may be greater in Tochigi Prefecture than in Osaka because the social burden of stroke is greater in Tochigi relative to other prefectures. Our study suggested that stroke education lessons improved knowledge about stroke in Tochigi Prefecture. Ishigami *et al*[17] showed that the percentages of total correct answers for stroke signs at baseline among parental guardians were: facial weakness, 67%; numbness on one side of the body, 76%; and speech disturbance, 93%. These percentages were lower than those in our study. However, that study obtained

Table 1 Percentages of correct responses among students

	BL (N=268)		IL (N=268)		3 Mo (N=268)		BL vs IL	BL vs 3 Mo	IL vs 3 Mo
	n	Percentage of correct answers	n	Percentage of correct answers	n	Percentage of correct answers	P value (after Bonferroni correction)		
Stroke signs and symptoms									
Correctly choosing correct answers									
Facial weakness in one side	188	70.1	268	100.0	267	99.6	<0.001	<0.001	1.00
Speech disturbance	236	88.1	268	100.0	267	99.6	<0.001	<0.001	1.00
Numbness in one side of the body	217	81.0	263	98.1	257	95.9	<0.001	<0.001	0.328
Correctly choosing incorrect answer									
Flatus	257	95.9	267	99.6	268	100.0	0.019	0.003	1.00
Stiff shoulders	228	85.1	265	98.9	261	97.4	<0.001	<0.001	1.00
Fever	193	72.0	265	98.9	262	97.8	<0.001	<0.001	1.00
Stomachache	267	99.6	268	100.0	266	99.3	1.00	1.00	1.00
Correctly choosing all correct and incorrect answers									
Answered all correctly	116	43.3	257	95.9	244	91.0	<0.001	<0.001	0.072
Attitude towards stroke									
Call an ambulance	198	73.9	259	96.6	249	92.9	<0.001	<0.001	0.038
Stroke risk factors									
Correctly choosing correct answers									
Hypertension	221	82.5	265	98.9	243	90.7	<0.001	0.006	<0.001
Hypercholesterolaemia	194	72.4	265	98.9	249	92.9	<0.001	<0.001	<0.001
Heavy drinking	199	74.3	266	99.3	250	93.3	<0.001	<0.001	<0.001
Smoking	188	70.1	267	99.6	251	93.7	<0.001	<0.001	<0.001
Correctly choosing incorrect answer									
Faecal impaction	245	91.4	263	98.1	264	98.5	0.003	<0.001	1.00
Affluence	259	96.6	267	99.6	268	100.0	0.064	0.012	1.00
Back pain	254	94.8	265	98.9	268	100.0	0.022	<0.001	0.750
Correctly choosing all correct and incorrect answers									
Answered all correctly	75	28.0	254	94.8	197	73.5	<0.001	<0.001	<0.001

3 Mo, 3 months after the lesson; BL, before the lesson; IL, immediately after the lesson.

Table 2 Percentages of correct responses among parental guardians

	BL (N=267)		IL (N=267)		3 Mo (N=267)		BL vs IL	BL vs 3 Mo	IL vs 3 Mo
	n	Percentage of correct answers	n	Percentage of correct answers	n	Percentage of correct answers	P value (after Bonferroni correction)		
Stroke signs and symptoms									
Correctly choosing correct answers									
Facial weakness in one side	197	73.8	253	94.8	254	95.1	<0.001	<0.001	1.00
Speech disturbance	265	99.3	263	98.5	262	98.1	0.157	1.359	1.00
Numbness in one side of the body	246	92.1	257	96.3	257	96.3	0.157	0.157	1.00
Correctly choosing incorrect answer									
Flatus	267	100.0	267	100.0	267	100.0	–	–	–
Stiff shoulders	240	89.9	259	97.0	255	95.5	0.002	0.008	1.00
Fever	267	100.0	267	100.0	264	98.9	–	–	0.75
Stomachache	267	100.0	267	100.0	267	100.0	–	–	–
Correctly choosing all correct and incorrect answers									
Answered all correctly	163	61.0	237	88.8	228	85.4	<0.001	<0.001	0.666
Attitude towards stroke									
Call an ambulance	218	81.6	252	94.7	249	93.3	<0.001	<0.001	1.00
Stroke risk factors									
Correctly choosing correct answers									
Hypertension	249	93.3	247	92.5	257	96.3	1.00	0.401	0.227
Hypercholesterolaemia	221	82.8	237	88.8	231	86.5	0.078	0.58	0.58
Heavy drinking	173	64.8	247	92.5	217	81.3	<0.001	<0.001	<0.001
Smoking	204	76.4	252	94.4	236	88.4	<0.001	<0.001	0.027
Correctly choosing incorrect answer									
Faecal impaction	257	96.3	260	97.4	263	98.5	1.00	0.328	1.00
Affluence	264	98.9	265	99.3	265	99.3	1.00	1.00	1.00
Back pain	265	99.3	266	99.6	263	98.5	1.00	1.00	1.00
Correctly choosing all correct and incorrect answers									
Answered all correctly	110	41.2	197	73.8	160	59.9	<0.001	<0.001	<0.001

3 Mo, 3 months after the lesson; BL, before the lesson; IL, immediately after the lesson.

Table 3 Attitude towards risk factors for stroke among parental guardians

	BL (N=242)		IL (N=242)		3 Mo (N=242)		BL vs IL	BL vs 3 Mo	IL vs 3 Mo
	n	%	n	%	n	%	P value (after Bonferroni correction)		
Controlled lifestyle modification and medical treatment	38	15.7	36	14.9	49	20.2	1.00	0.01	0.17
Engaged in lifestyle modification (uncontrolled) and medical treatment	10	4.1	14	5.8	20	8.3			
Intend to change behaviour but not yet started	101	41.7	98	40.5	90	37.2			
Doing nothing in particular	93	38.4	94	38.8	83	34.3			

3 Mo, 3 months after the lesson; BL, before the lesson; IL, immediately after the lesson.

similar outcomes to the present study for risk factors. Generally, it is difficult for a population with good stroke knowledge to improve this knowledge; this is called a 'ceiling effect.' However, our study demonstrated that lessons were effective for improving stroke knowledge.

For the question regarding whether to call an ambulance at the onset of a stroke, the percentage of correct answers among parental guardians at baseline in our study was slightly lower than that in a previous study.[11] The rate of people transported by emergency medical services (EMS) in Tochigi has always been lower than that in Osaka (Tochigi: 398.0 per 100 000 population vs Osaka: 622.3 per 100 000 population in 2015).[19] Moreover, there are 5.5 hospitals and 1089.5 hospital beds per 100 000 population in Tochigi compared with 6.0 hospitals and 1219.7 hospital beds per 100 000 population in Osaka.[19] This suggests that the difference in response between the studies may stem from the different prefectural characteristics. Stroke programmes may increase the number of people transported by EMS in rural areas such as Tochigi and may promote the diffusion of appropriate care.

Previous research involving education programmes indicated that children communicated their disease knowledge with their parents. Williams *et al* reported that a child-mediated stroke education programme improved the percentage of respondents that selected all stroke symptoms and risk factors correctly.[27] However, they did not report improved correct responses for some stroke symptoms. Our research showed similar results to that study. In our study, participating students and parental guardians had good stroke knowledge at baseline because: (1) a stroke education programme using mass media started in 2012 in the study area and (2) Japanese students are expected to study non-communicable diseases (cancer and cardiovascular disease) in health and physical education lectures, as set out in educational guidelines for elementary and junior high schools.[28 29]

Another study described a children-to-parents education programme for non-communicable diseases.[30] In that study, students accepted the school-based intervention, shared health information with their parents and encouraged this behaviour in their parents. As a result, students' mothers increased their physical activity and lost weight. Although the parents did not attend the lesson directly, they improved their behaviour with respect to risk factors. Similar results were observed in the present study, with parental guardians reporting improved health behaviours. Stroke education may be particularly effective for participants who previously (before the lesson) neglected their health. In addition, this programme may encourage participants to move from modifying their health behaviours to maintenance of healthy behaviours. Because children shared stroke knowledge with their parental guardians, they may monitor and encourage one another's healthy behaviours.

The lessons in the present study were conducted by eight adjunct instructors with differing educational and occupational backgrounds. However, all instructors used the same educational tools, focusing on the FAST mnemonic (described in the manga and cartoon animation) developed by the National Cerebral and Cardiovascular Center.[31 32] Our study showed no significant differences in terms of the instructors' backgrounds in the percentages of students' and guardians' correct answers (data not shown).

Our study has several limitations. First, the sample size was small; however, this is the first report on the effect of an education programme on knowledge about stroke among elementary school students in a sparsely populated area. Second, participating parental guardians did not show significant improvement in knowledge about stroke risk factors. We believe this was because of a 'ceiling effect,' as the percentage of correct answers at baseline was higher than in previous studies.[16 17] Third, our study did not adjust for some potential confounders, including medical history and socioeconomic status (eg, educational status, income and occupation) for parental guardians, academic performance for students and the existence of relatives with stroke. Finally, we did not assess real change in behaviour for risk factor control and real attitude during a stroke. Further research to address these limitations is warranted.

CONCLUSION

In a rural population with relatively high knowledge about stroke symptoms and risk factors, stroke education delivered by multidisciplinary instructors using animated cartoons and informational manga improved stroke knowledge among elementary school students and their parental guardians. In addition, the student-mediated programme improved behaviour regarding risk factors. Stroke education in

elementary schools may be effective in changing students' and parental guardians' behaviour regarding stroke risk factors, as it has a simultaneous impact on two generations. However, assessment of the real impact on behavioural changes in communities requires further research in a large population with long-term follow-up.

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Competing interests None declared.

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