Child-Mediated Stroke Communication
Findings From Hip Hop Stroke

Olajide Williams, MD, MS; Alexandra DeSorbo, MPH; James Noble, MD, MS; William Gerin, PhD

Background and Purpose—Low thrombolysis rates for acute ischemic stroke are linked to delays in seeking immediate treatment due to low public stroke awareness. We aimed to assess whether “Child-Mediated Stroke Communication” could improve stroke literacy of parents of children enrolled in a school-based stroke literacy program called Hip Hop Stroke.

Methods—Parents of children aged 9 to 12 years from 2 public schools in Harlem, New York City, were recruited to participate in stroke literacy questionnaires before and after their child’s participation in Hip Hop Stroke, a novel Child-Mediated Stroke Communication intervention delivered in school auditoriums. Parental recall of stroke information communicated through their child was assessed 1-week after the intervention.

Results—Fifth and sixth grade students (n=182) were enrolled into Hip Hop Stroke. One hundred two parents were approached in person to participate; 75 opted to participate and 71 completed both the pretest and post-test (74% response rate and 95% retention rate). Parental stroke literacy improved after the program; before the program, 3 parents of 75 (3.9%) were able to identify the 5 cardinal stroke symptoms, distracting symptom (chest pains), and had an urgent action plan (calling 911) compared with 21 of 71 parents (29.6%) postintervention (P<0.001). The FAST mnemonic was known by 2 (2.7%) of participants before the program versus 29 (41%) after program completion (P<0.001).

Conclusions—Knowledge of stroke signs and symptoms remains low among residents of this high-risk population. The use of Child-Mediated Stroke Communication suggests that school children aged 9 to 12 years may be effective conduits of critical stroke knowledge to their parents.

Key Words: acute stroke ■ cerebrovascular accident ■ education ■ prevention ■ public health

Stroke affects 795 000 Americans each year and of these, 610 000 are first attacks.1 National samples have consistently shown up to a 3-fold greater stroke incidence in black compared with non-Hispanic white Americans, especially among those aged 34 to 55 years, and a 2-fold increase in mortality.2,3 Emergency treatment for ischemic stroke using intravenous tissue-type plasminogen activator can increase the odds of minimal to zero disability at 3 months by 31% to 50%.4,5 However, to be effective, tissue-type plasminogen activator must be administered within no more than 4.5 hours from symptom onset,4,5 although the best outcomes are seen when treatment begins within 90 minutes of stroke onset.6 Unfortunately, only 3% to 5% of patients with ischemic stroke in the United States receive the treatment,7 mostly due to the latency between recognition of symptoms and arrival at the hospital.8,9 This latency has been linked to poor public knowledge concerning stroke symptoms and the appropriate urgent response to symptoms (calling 911) when they occur. Interventions designed to educate patients to seek treatment sooner when a stroke occurs may increase thrombolysis rates to 57%, if emergency medical system response times and in-hospital response times are optimized.8,10

Data from 61 019 adults participating in the 2001 Behavioral Risk Factor Surveillance System revealed that although most persons recognized 1 to 3 symptoms, only 9% for blacks versus 19% for whites were aware of the 5 cardinal symptoms of stroke (sudden confusion or trouble speaking; sudden numbness or weakness of face, arm, or leg, especially on 1 side of the body; sudden trouble seeing in 1 or both eyes; sudden trouble walking, dizziness, or loss of balance; sudden severe headache with no known cause) and would call 911 if they thought that someone was having a stroke.11 In a similar survey of 1023 residents in Central Harlem, a predominantly black high stroke-risk population, our group reported significant deficiencies in knowledge of stroke symptoms,12 consistent with the Behavioral Risk Factor Surveillance System survey, emphasizing the need for stroke awareness campaigns tailored to vulnerable populations.

Novel strategies for improving rapid recognition of stroke could include educating children about the time-urgent nature
of stroke symptoms along with primary prevention.\textsuperscript{13} Stroke-educated children might rapidly activate the emergency medical system if a family member suffers a stroke. Increases in the number of children living with grandparents and individuals delaying giving birth until after age 30 years resulting in more children living with older parents\textsuperscript{14,15} support recommendations to expand health education for children to include stroke knowledge.

Hip Hop Stroke (HHS)\textsuperscript{16} is a school-based stroke communication intervention that uses what we have termed “Child-Mediated Stroke Communication,” a paradigm in which children may serve as a means of delivering an intervention to the target population (their parents and grandparents—whom we will now collectively call parents—in their households). HHS uses a modular multimedia curriculum and Hip Hop music to teach children aged 9 to 12 years the 5 cardinal stroke symptoms, the correct course of action when they occur, and stroke prevention measures (collectively termed “stroke literacy”) to increase parental stroke literacy and the stroke literacy of the kids themselves.

Methods

The study population, Central Harlem, is a predominantly black (two thirds of all residents), high-risk population with a high proportion of the population living under the federal poverty level and a high stroke death rate.\textsuperscript{17} The authors refined the content of our previously reported HHS intervention\textsuperscript{16} with input from members of the target community, including school-aged children, and behavioral scientists. The intervention is based on 2 theories that have been demonstrated as important predictors of behavior change: (1) Reasoned Action Theory, which suggests that a series of related cognitive constructs operate to produce an intention to act, which is a precursor to engaging in the act or the desired outcome (ie, making use of the stroke information as part of standard practice)\textsuperscript{14,16} and (2) Self-Efficacy Theory, which posits that control over one’s outcomes produces a sense of mastery for those behaviors and that increased self-efficacy predicts increased motivation to engage in the desired behaviors as well as a demonstrated increase in the behavior itself.\textsuperscript{19}

The refined HHS intervention is a 3-day/1 hour-per-day multimedia classroom intervention that uses Hip Hop songs written by a well-known artist, 2 4-minute professionally produced cartoon music videos, and a comic book to teach stroke literacy (Figure; Supplemental Table I, http://stroke.ahajournals.org; see http://hiphoppublichealth.org/stroke for video and comic book). A stroke mnemonic, “FAST” (“F” for “Face droop,” “A” for “Arm weakness,” “S” for “Speech affected/slurred,” and “T” for “Time to call 911”), derived from the Cincinnati prehospital stroke scale\textsuperscript{20} and other stroke symptoms not part of the “FAST” mnemonic, were incorporated into the songs and overall curriculum. Five stroke symptoms were used to capture the major components of the Behavioral Risk Factor Surveillance System symptoms with some modifications. These included sudden slurred/confused speech, sudden blurred vision (or loss of vision), sudden clumsiness/imbalance, sudden severe headache for no known reason, and sudden facial weakness/droop. This latter symptom, sudden facial weakness, was taught in the context of 1-sided weakness of the face, arm, and leg, although separate variables for limb weakness and numbness were not measured. Other teaching methods included role-play to rehearse calling 911 in the event of a stroke and “acting out” the cardinal stroke symptoms in skits. Parental engagement homework assignments in the form of “Hip Hop To-Go” kits (see the Figure) were included to supplement the in-class materials and facilitate an increase in parental stroke knowledge through Child-Mediated Stroke Communication. Students were encouraged to view a DVD (containing the 2 4-minute cartoons) with their parents, review a comic book with their parents, become “stroke reporters” by surveying their parents on stroke knowledge with a “tear-off” questionnaire located at the back of the comic book (evidence of parental engagement), and convince their parents to place a HHS refrigerator magnet in a prominent place in their homes.

The current study assesses the potential public health impact of HHS beyond the classrooms by testing the following prespecified hypothesis on which our outcomes were based: (1) children enrolled in the HHS intervention will attempt to educate parents about stroke; and (2) parents engaged by enrolled children will demonstrate increased stroke knowledge and the appropriate course of action in the event of a stroke using hypothetical real world scenarios 1 week

**Figure.** Hip Hop to-go homework tools. A, Excerpt from “Stroke Ain’t No Joke” stroke recognition comic book. B, Scenes from “Stroke Ain’t No Joke” stroke recognition animated cartoon video. C, Scenes from “Keep Your Brain Healthy” stroke prevention animated cartoon video.
Table 1. Patterns of Learned Basic Stroke Knowledge and a Stroke Mnemonic Across the Test Sequence

<table>
<thead>
<tr>
<th></th>
<th>Stroke Localization (Expected Value 25%)</th>
<th>Stroke is a Brain Attack; (Expected Value 25%)</th>
<th>FAST Mnemonic (Expected Value 0)</th>
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<td>Pretest</td>
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<td>60 (84.5)‡</td>
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<td>15 (88.2)‡</td>
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<td>13 (81.3)*</td>
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<td>High school graduate/graduate equivalency degree/some college</td>
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<td>26 (83.9)†</td>
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</tr>
<tr>
<td>College graduate</td>
<td>14 (70.0)§</td>
<td>18 (90.0)*</td>
<td>7 (35.0)</td>
</tr>
</tbody>
</table>

*P<0.05; †P<0.01; ‡P<0.001; all comparisons are pretest vs post-test for each individual question by row unless otherwise noted.
§P<0.05; test for significance by column (for each questions) using Pearson χ² test (or test of linear relationship for education or age) relative to stroke knowledge question.

after the completion of the HHS intervention. This second hypothesis—parental stroke knowledge—formed the basis of our primary outcome measure (Supplemental Figure II), whereas proof of parental engagement captured by our first hypothesis was a secondary measure.

After obtaining approval from the Institutional Review Board at Columbia University, a sample of fifth and sixth grade students (N=182; ages 9–12 years) were recruited into the HHS intervention from 2 schools in Central Harlem. Two weeks before program initiation, parents of students were contacted in person at 3 prespecified in-school parent meetings arranged by school staff and consented to complete a pretest stroke literacy questionnaire that included demographic information (Table 1). All participating parents verified that they were the primary caregivers to the participating student and the individual at home with whom the child would be most likely to share information. Two trained lay-health facilitators delivered the intervention in English to the children in both schools. Parents did not participate in the school-based program. Returned student homework (“tear-off” from the comic book) assignments requiring parental participation were used as proof of parental engagement (“likelihood of discussing materials”). Small incentives, including comic book T-shirts, baseball caps, and wristbands, were given to children who returned the homework assignment (“tear-off” comic book questionnaire) completed by their parent. Parental recall of stroke information communicated by their child was assessed by post-test questionnaires (Supplemental Figure II) administered by telephone 1 week after the children had participated in the intervention.

Data Analysis

Hypothesis 1
In the post-test instrument (Supplemental Figure II), we collected yes/no responses to the questions regarding communication by the child. We also collected homework assignments (“tear-off” comic book questionnaire) completed by the parent from the child.

Hypothesis 2 (Primary Outcome Measure)
Stroke symptom questions on our instrument (Supplemental Figure II) were answered as either yes or no, whereas other questions were multiple choice (call 911 using case scenarios, stroke localization or knowledge that a stroke occurs in the brain, and identifying the term “brain attack”) or open response (naming components of the FAST mnemonic). Knowledge of stroke prevention was also assessed using open responses. We compared pretest versus post-test performances by individual across the test sequence using the Wilcoxon signed-ranks test (PASW Statistics Version 17.0; SPSS, Inc, Chicago, IL). To improve comparability to Behavioral Risk Factor Surveillance System measures, we developed a composite of stroke symptoms; a distracter (chest pain), and an urgent action plan (call 911).

Stroke Literacy and Demographic Characteristics
We explored stroke knowledge responses relative to age, sex, race–ethnicity, and education, comparing prepost performance within the strata. Simple ORs were determined using binary logistic regression.

Results
A total of 102 parents of children in our sample were contacted in person at 3 prespecified in-school parent meetings during the 2-week lead-in period. This total number of parent contacts was limited by the short lead-in period and recruitment method selected by investigators. No child contributed >1 adult parent. Seventy-five parents opted to participate (74%), and 71 (74%) completed both the pretest and post-test. Parents’ ages ranged from 25 to 74 years, 72% non-Hispanic black, and 24% Hispanic, 1% Asian Pacific Islander, 3% “other,” 45% had a high school diploma or less, 27% had some college, and 28% were college graduates or had an advanced degree (Table 1). Of the original 75 participating parents, most identified themselves as parents (61) followed by “relative” (3), grandparent (2), aunt/uncle (1), sibling or stepsibling (1), or not identified (7).

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Hypothesis 1

All 71 parents who completed both the pretest and post-test indicated that their children communicated stroke information to them (100%), and of these, 54 (75%) were confirmed by returned homework assignments collected on the final day of the 3-day HHS intervention.

Hypothesis 2

Parental stroke literacy improved after the program (Tables 1, 2, and 3). Parents were more likely to correctly report stroke localization after the program (51% correct at baseline versus 85%, P<0.001). In an open-response question, the FAST stroke mnemonic was correctly known by 2 (2.7%) of participants before the program versus 29 (41%) after the program had ended (P<0.001). Knowledge of stroke prevention measures significantly improved from a mean of 0.77 items named before the intervention compared with 1.08 afterward (P=0.001). Before the program, only 3 of the 75 parents (3.9%) were able to correctly identify the 5 cardinal stroke symptoms (slurred speech/confusion, facial droop, blurred vision, clumsiness/imbalance, severe/unexplained headache), a nonstroke distracter (chest pains), and had an urgent action plan (calling 911) compared with 21 of the 71 parents (29.6%) postintervention (P<0.001). Fifty-two percent of parents were able to correctly identify at least 4 of 6 symptoms (including distracter) and this increased to 91.6% afterward (P<0.001; Supplemental Figure III). Review of individual stroke symptom responses suggested improved likelihood of message retention for those included in the FAST mnemonic (Supplemental Figure IV); facial paresis and slurred speech were identified in a high proportion of participants before the intervention (72.0% and 77.3%, respectively, P<0.01 [Pearson χ² test for both when compared with headache but not statistically significantly higher than blurry/loss of vision).

Stroke Literacy and Demographic Characteristics

We explored possible effects of sociodemographic factors on stroke knowledge learning (Tables 1–3). Greater educational attainment was associated in a dose–response manner with stroke knowledge on several questions on the pretests: stroke localization (P test of trend =0.03), stroke symptoms: slurred speech (P=0.02), facial paresis (P=0.003), and clumsiness (P=0.004) as well as correctly identifying all stroke symptoms and chest pain as a distracter (P=0.01). However, education was more predictive of post-test performance: identifying stroke as a “brain attack” (P=0.01) and stroke symptom slurred speech (P=0.009). In the pretest period, higher education predicted better knowledge of stroke localization (college graduates versus less than high school: OR, 4.33; 95% CI, 1.15–16.32) as well as stroke symptom recognition: slurred speech (high school graduate versus less than high school: OR, 4.50; 95% CI, 1.13–17.88; college graduates versus less than high school: OR, 6.00; 95% CI, 1.08–33.27), facial paresis (high school graduate versus less than high school: OR, 5.20; 95% CI, 1.42–19.04; college graduates versus less than high school: OR, 9.00; 95% CI, 1.64–49.45), and clumsiness (college versus less than high school: OR, 7.43; 95% CI, 1.78–31.04). In the post-test, college graduates were 6.67 (95% CI, 1.50–29.63) times more likely than those with less than high school education to correctly call a stroke a “brain attack.” In comparison to...
Table 2. Continued

<table>
<thead>
<tr>
<th>Chest Pain</th>
<th>Clumsiness or Imbalance</th>
<th>Headache</th>
<th>Hypothetical Scenario</th>
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<tr>
<td>(Not Symptom, Expected Value 50%)</td>
<td>(Expected Value 50%)</td>
<td>(Expected Value 50%)</td>
<td>Urgent Action Plan (Call 911, Expected Value 25%)</td>
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<td>Pretest</td>
<td>Post-Test</td>
<td>Pretest</td>
<td>Post-Test</td>
</tr>
<tr>
<td>18 (24.0)</td>
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<td>5 (25.0)</td>
<td>13 (65.0)</td>
<td>16 (80.0)</td>
<td>20 (100.0)</td>
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</table>

Effectively addressing these knowledge gaps with evidence-based models is important steps followed by trials evaluating their behavioral effect on reducing prehospital delays. Conventional, most health education programs have assumed that communication of health information flows from parent to child and not the reverse. To our knowledge, only 2 studies—one asthma study and 1 hypertension study—have successfully shown that young children are able to initiate health communications with parents and affect parental health behavior. Open Airways for Schools showed that children with asthma were able to successfully teach their parents new patterns of asthma self-management at home. A school-based hypertension program showed that children might improve parents’ knowledge about hypertension and increase the likelihood the parents will consult their physician about their blood pressure. Each has successfully demonstrated that young children are educable about stroke, and 1 program, HHS, reported emergency medical system activation by stroke-educated children. To date, no program has successfully demonstrated that stroke-educated children can effectively transfer stroke knowledge to adult family members due to low parental participation, high attrition rates, or the absence of data. The Kids Identifying and Defeating Stroke study, a randomized controlled trial, found engagement of parents challenging and were unable to report results on knowledge transfer to parents due to low parental response rates.

Based on the success of HHS, child-mediated health communication may serve as the basis for intervention in any number of content areas such as medication adherence and healthy eating. This model may represent an innovative vehicle for public health education because of its potential to: (1) provide public health officials with a “captive” audience in the schools; (2) improve child health literacy and risk-related behaviors; (3) use children’s access to their parents to...
influence parental health literacy and risk-related behaviors; and (4) provide a cost-effective alternative to expensive mass media campaigns. Thus, the significance of our study is not limited to the public health problem under study—stroke symptom identification and urgent response—but also to the potential development and refinement of a more general model of intervention.

Despite the large effect sizes found, several limitations of our study should be mentioned. Our report is a nonrandomized single arm pretest post-test design, whose limitations may include the threat of instrument reactivity. However, the instrument, which encompasses only the knowledge domain (either the child did or did not report; either the parent can or cannot recall specific items), reduces the likelihood that parental knowledge is subject to reactive bias. Another limitation is the inability to control for contamination from other local public health stroke education programs; however, low baseline knowledge and short follow-up duration reduce the likelihood of this. A low number of parents, 56% (102 of 182), were approached, and of these, our response rate was 74%. However, the total number of recruited parents represented 41% (75 of 182) of the potential sample. This low percentage could have introduced bias into our findings, although even if those not responding to the survey had learning nothing, the results in this report still would indicate significant gains in stroke knowledge in a population with very low baseline stroke awareness. The short follow-up period precludes assessment of long-term retention by parents. We did not assess parental occupation, which could better inform patterns of stroke awareness confounded by education and race–ethnicity. We acknowledge that our study of potentially explanatory sociodemographic factors for stroke knowledge is exploratory and associated findings may be an artifact of multiple comparisons. Moreover, given the small sample size, we were unable to simultaneously control for various socioeconomic confounders, which often covary, precluding definitive conclusion. However, considering that analyses of educational attainment suggested both a dose–response and greater differences in pretest performance associated with higher educational attainment, we plan to explore this further in future study. In addition, our study did not assess which elements of HHS were most responsible for improving parental knowledge; these could include standalone assessments of the related songs, cartoons, and comic book or informal conversation related to learning from the program.

In summary, we have shown data that support the viability of a Child-Mediated Stroke Communication model for stroke awareness and consideration of child-mediated health communication when developing other public health programs. Randomized controlled studies are needed to confirm these findings and assess behaviors related to improved community stroke literacy.

Acknowledgments

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Disclosures

None.

References


Table 3. Summary of Proportion Stroke Symptoms Recognized and Development of Urgent Action Plan

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<tr>
<th>Race–ethnicity</th>
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<td><strong>Age, y</strong></td>
<td><strong>Correctly (Expected Value 1.2%)</strong></td>
<td><strong>Correctly (Expected Value 1.2%)</strong></td>
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<td><strong>Called 911 (Expected Value 1.2%)</strong></td>
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</table>

*P<0.05; †P<0.01; ‡P<0.001; all comparisons are pretest vs post-test for each individual question by row unless otherwise noted.

§P<0.05; test for significance by column (for each questions) using Pearson χ² test (or test of linear relationship for education or age) relative to stroke knowledge question.


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### Supplemental Table 1: Hip Hop Stroke Curriculum (SUPPLEMENTAL/ONLINE TABLE)

<table>
<thead>
<tr>
<th></th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
</tr>
</thead>
</table>
| **Topic** | • Pre-test evaluation of baseline stroke knowledge  
• Stroke Recognition module  
• Introduction of home activities | • Stroke Prevention and Risk Reduction module  | • Review of days 1 & 2  
• Early Post-test |
| **Content** | 1) Demonstration of audience response system and pre-test  
2) Stroke Recognition module:  
   a. Review digital brain function maps  
   b. Animation of ischemic and hemorrhagic stroke  
   c. “Stroke Ain’t No Joke” cartoon showing the “FAST” mnemonic & “suddens” stroke symptoms; child’s role in stroke identification/ 911 calls.  
   d. Role-play; prizes awarded.  
   e. Children encouraged to engage parents. Given Hip Hop To Go homework packet | 1] Review of Day 1  
2] Stroke Prevention module  
   a. Demo with atherosclerosis blood vessel model; Review of high blood pressure, obesity, smoking, diabetes.  
   b. “Keep your brain healthy” cartoon highlighting stroke risk and prevention & child’s role in the family/community health structure.  
   c. Children encouraged to engage parents. Review of home activities | 1] Review days 1&2;  
2] Repeat both cartoons  
3] Hip Hop To Go comic book survey collection  
4] Child encouraged to engage parents  
5] Early Post Test |
Supplemental figure 2: Parental stroke knowledge pre/posttest

(SUPPLEMENTAL/ONLINE)

PRE and POSTTEST:
Assessment of parent/caregiver stroke knowledge and communication

1. Has your “child” (or grandchild or other) told you about participating in HHS at school and discussed stroke information with you? (POSTTEST ONLY)

YES NO

2. Do you recall what your “child” communicated regarding the symptoms and recommended action? (POSTTEST ONLY)

YES NO

Stroke knowledge:

3. Do you know the part of the body where a stroke occurs? (PRE AND POST TESTS)

YES (record answer below)

NO [If uncertain or incorrect, give the following choices]:
heart lungs brain kidneys

4. What is another name for stroke? (PRE AND POST TESTS)

[RECORD SPONTANEOUS ANSWER]

[If unknown, give the following choices:]
Heart attack Seizure Brain attack Hay fever

5. Have you heard of the letters “FAST” in the context of recognizing stroke symptoms—that is, do you know what “F” -“A”- “S”- “T” stands for? (PRE AND POST TESTS)

YES NO [If yes, RECORD SPONTANEOUS ANSWER]

6. Do you know any stroke warning signs? (PRE AND POST TESTS)

YES NO

If yes, please name some:

[RECORD SPONTANEOUS ANSWER]

[For all respondents, give the following choices]:

a) Sudden blurred/loss of vision Yes No
b) Sudden chest pains Yes No
c) Sudden facial droop/weakness Yes No
d) Sudden slurred speech or confusion  Yes  No

e) Sudden coughing hard  Yes  No

f) Sudden headache for no known reason  Yes  No

g) Sudden imbalance/clumsiness  Yes  No

h) Sudden stomach ache  Yes  No

7. Do you know what you should do if you think you or someone you know has any of the warning signs? (PRE AND POST TESTS)

YES  NO  UNCERTAIN

[If yes, RECORD SPONTANEOUS ANSWER]______________________________________________________________

[If NO or UNCERTAIN, give the following scenario]

8. If this happened to you or an adult friend/relative what would you do? (PRE AND POST TESTS)

“She was talking to you in the living room when you noticed that her speech became garbled all-of-a-sudden as though she were drunk. This has never happened before.”

Would you (circle one):

a) Tell them to drink lots of water,
b) Tell them to lie down to take a nap,
c) Call 911 immediately,
d) Tell them to call the family doctor

9. Knowledge of stroke prevention (PRE AND POST TESTS)
Do you know about any measures or steps you can take to prevent a stroke? If so, please list them below.
______________________________________________________________

10. Have you or do you know a close relative or family friend who has had a stroke (please specify)? (PRETEST ONLY) __________
Cumulative proportion of adult participants able to correctly identify some of 5 stroke symptoms and 1 distracter (total score range: 0 to 6), before and after intervention. Knowledge of stroke symptoms significantly improved after the intervention (p<0.001, Wilcoxon signed ranks test).
Supplemental figure 4:

Proportion correctly identifying stroke symptoms and a distracter, relative to the F.A.S.T. stroke mnemonic. (SUPPLEMENTAL/ONLINE)

For symptoms within F.A.S.T. on post-tests, all p<0.01 compared with headache but NS compared with blurred vision.