Knowledge of Tissue Plasminogen Activator for Acute Stroke Among Michigan Adults

Beth E. Anderson, MPH; Ann P. Rafferty, PhD; Sarah Lyon-Callo, MA, MS; Chris Fussman, MS; Mathew J. Reeves, PhD

Background and Purpose—Although tissue plasminogen activator (tPA) is an effective therapy for acute ischemic stroke, treatment rates remain low. Efforts to address the underuse of tPA include public education to increase the recognition of stroke symptoms and the awareness of tPA treatment. Our objective was to determine the level of knowledge about tPA treatment for acute stroke among a representative sample of Michigan adults.

Methods—The Michigan Behavioral Risk Factor Survey (BRFS) is a random-digit-dial telephone survey of adults conducted annually as part of the national BRFS. Questions regarding tPA treatment for acute stroke were included in the 2004 Michigan BRFS. We examined the prevalence of awareness using $\chi^2$ tests and generated multivariable logistic regression models.

Results—Among 4724 respondents, only 32.2% (95% CI = 30.8 to 33.8%) were aware of the existence of tPA treatment for acute stroke, of whom 52.7% (50.0 to 55.4%) knew that it needed to be administered within 3 hours of symptom onset. Awareness of tPA was higher among middle aged adults, females, whites, and those with higher education and income. Awareness of the time window for tPA was higher among middle aged adults and whites.

Conclusions—In this population-based survey only a third of the public were aware of tPA as a treatment for stroke, and only 1 in 6 were aware that the treatment exists and needs to be given within 3 hours of symptom onset. Continuing efforts are necessary to increase public knowledge about tPA treatment for acute stroke. (Stroke. 2009;40:2564-2567.)

Key Words: thrombolysis ■ public awareness ■ stroke

Stroke is the third leading cause of death in the United States and a leading cause of long-term adult disability. Every year approximately 780,000 people experience a stroke. Intravenous tissue plasminogen activator (tPA) has been shown to reduce disability from stroke if administered within 3 hours of symptom onset. However, tPA treatment rates in the United States and elsewhere remain low—less than 5% of acute ischemic stroke cases receive treatment. Various studies have shown that delayed presentation to the hospital is the single most important reason that stroke patients do not receive tPA. Studies of stroke-related knowledge have primarily focused on warning signs and risk factors. At least 3 telephone-based surveys have included questions about awareness of tPA treatment for stroke, and their results have varied widely. In a 1999 study conducted in Corpus Christi, Tex, 48% of Hispanics and 57% of non-Hispanic whites were aware that a treatment for acute stroke existed, and 38% and 62%, respectively, were aware that there was a time window for stroke treatment. In a 2003 survey of US women, the majority (92% of whites, 84% of blacks, and 79% of Hispanics) thought the following statement was true, “At the onset of a stroke, treatment can be given to break up blood clots.” Results from a 2005 population-based survey in the Cincinnati, Ohio area estimated that 19% were aware of tPA.

We chose to determine the level of awareness of tPA as a treatment for acute stroke among a representative population-based sample of Michigan adults and to compare it to other population-based estimates from the United States.

Materials and Methods

The Michigan Behavioral Risk Factor Surveys (MiBRFS) are annual random-digit-dial telephone surveys of Michigan adults conducted annually in cooperation with the Centers for Disease Control and Prevention as part of the national Behavioral Risk Factor Surveillance System (BRFSS). The following 3 questions on knowledge of tPA were added to the Michigan 2004 survey: “Have you heard of a new clot-busting drug that can be used to treat some persons who have had a stroke? This drug is also called tPA.” Those who responded affirmatively were asked, “Do you know within how many hours after a stroke begins this drug needs to be given to be effective? (If yes) How many hours?”

A question assessing knowledge of stroke warning signs was also included in the 2004 MiBRFS, ie, “Next, I would like to ask you about warning signs for stroke; that is, what are the first symptoms...”

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or signs that someone is having a stroke. From anything you might have read or heard, what do you think are the 3 most important signs of a stroke? Responses were coded as correct, incorrect, or neither. Correct responses were defined according to standard definitions used by the American Stroke Association, and adequate knowledge of risk factor warning signs was defined as reporting 3 correct warning signs.12,13

Data were weighted to account for probabilities of selection and poststratified to the state-level adult population by age, race, and sex. Percents and 95% confidence intervals were calculated using SUDAAN to account for the complex study design. Statistical significance of bivariate associations between demographic variables and tPA awareness were determined using \( \chi^2 \) and linear tests for trend. Associations were further examined using multivariable logistic regression analysis; all demographic variables were included in the model regardless of significance.

**Results**

The response rate for the 2004 MiBRFS was 48.4%, which was slightly below the median BRFSS response rate for all states (median 52.7%, range 32.2% to 66.6%).11 Total sample size was 4785; 61 respondents reported that they did not know whether or not they had ever heard of tPA and were eliminated from the analysis, leaving a working sample size of 4724. Respondents to the 2004 MiBRFS tended to be slightly older than the Michigan adult population (24% of 4724. Respondents to the 2004 MiBRFS tended to be slightly older than the Michigan adult population (24% of MiBRFS respondents were aged \( \geq 65 \) years versus 16% of the adult Michigan population), were more likely to be female (61% MiBRFS versus 52% Michigan adults), and less likely to be nonwhite (14% MiBRFS versus 16% Michigan adults). However, once weighted the percentages of 65 years or older, female, and nonwhite in the 2004 MiBRFS (17%, 52%, and 15%) were much closer to population values, as would be expected.

One-third of respondents (32.2%) reported that they had heard of tPA (Table 1). Awareness of tPA was significantly associated with all demographic characteristics examined. The proportion aware increased with age up until 55 to 64 years, but was lower among those aged 75 years and older. Awareness was also higher among women, whites, and those with higher levels of education and household income. All associations remained significant in the multivariable logistic regression model (Table 1). For example, the adjusted odds of being aware of tPA were 4 times higher among those aged 55 to 64 years, compared with those 18 to 34 years (AOR = 4.10, 95% CI = 3.12 to 5.40). The adjusted odds of being aware of tPA was 35% higher in women but 40% lower among blacks (compared to whites).

Of those who had heard of tPA, 27.1% (95% CI = 24.9 to 29.5) reported that it should be administered within an hour or less, 13.0% (95% CI = 11.3 to 14.9) within 2 hours, 12.6% (95% CI = 10.9 to 14.4) within 3 hours, 16.3% (95% CI = 14.3 to 18.3) within 4 or more hours, and 31.0% (95% CI = 28.6 to 33.8) reported they did not know. Among those who reported 4 or more hours, the range was 4 to 76 hours, with a median of 6 hours. Overall, over half of those aware of tPA (52.7%) knew that it should be administered within 3 hours after stroke onset (Table 2); this represents 16.8% (95% CI = 15.7 to 17.9) of all respondents. The proportion aware of the tPA time window increased significantly with age and was significantly lower in blacks. However, in contrast to having heard of tPA, awareness of the time window for tPA was slightly below the median BRFSS response rate for all demographic characteristics. The response rate for the 2004 MiBRFS was 48.4%, which was statistically significant after multivariable analysis. The associations with age and race remained statistically significant after multivariable analysis.

As reported previously, 27.6% of respondents were able to report 3 correct stroke warning signs.13 The proportion aware that tPA treatment exists and needs to be administered within 3 hours increased with increasing knowledge of stroke warning signs, from 5.9% (95% CI = 4.4 to 7.8) among those who were unable to report any stroke warning signs, to 10.9% (8.9 to 13.3%) of those who reported 1 warning sign, 18.2% (16.4 to 20.2%) who reported 2, and 26.3% (23.9 to 28.9%) who reported 3 warning signs. Those with adequate knowledge of warning signs (ie, reported 3 correct) were twice as likely to know about tPA and its treatment time window compared with those without adequate knowledge (26.3% versus 13.2%, \( P < 0.0001 \)). However, even among those with treatment was not associated with sex, education, or household income. The associations with age and race remained statistically significant after multivariable analysis.

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Prevalence % (95% CI)</th>
<th>Adjusted Odds Ratio† (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>32.2 (30.8–33.8)</td>
<td></td>
</tr>
<tr>
<td><strong>Age, y</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–34</td>
<td>16.3 (13.8–19.2)§§</td>
<td>1.00</td>
</tr>
<tr>
<td>35–44</td>
<td>32.0 (28.8–35.4)</td>
<td>2.07 (1.59–2.70)</td>
</tr>
<tr>
<td>45–54</td>
<td>41.1 (37.8–44.5)</td>
<td>3.03 (2.34–3.93)</td>
</tr>
<tr>
<td>55–64</td>
<td>46.8 (43.1–50.6)</td>
<td>4.10 (3.12–5.40)</td>
</tr>
<tr>
<td>65–74</td>
<td>43.8 (39.6–48.0)</td>
<td>3.82 (2.84–5.13)</td>
</tr>
<tr>
<td>≥75</td>
<td>33.8 (29.5–38.4)</td>
<td>2.90 (2.09–4.02)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>29.5 (27.2–31.8)‡</td>
<td>1.00</td>
</tr>
<tr>
<td>Females</td>
<td>34.7 (32.8–36.7)</td>
<td>1.35 (1.15–1.58)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>34.6 (33.0–36.2)‡§</td>
<td>1.00</td>
</tr>
<tr>
<td>Black</td>
<td>20.4 (16.3–25.3)</td>
<td>0.60 (0.44–0.82)</td>
</tr>
<tr>
<td>Other</td>
<td>24.7 (19.2–31.2)</td>
<td>0.74 (0.51–1.08)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; High school graduate</td>
<td>18.8 (14.7–23.8)§§</td>
<td>1.00</td>
</tr>
<tr>
<td>High school graduate</td>
<td>27.9 (25.4–30.5)</td>
<td>1.51 (1.04–2.20)</td>
</tr>
<tr>
<td>Some college</td>
<td>34.3 (31.5–37.2)</td>
<td>2.13 (1.46–3.11)</td>
</tr>
<tr>
<td>College graduate</td>
<td>38.6 (35.9–41.4)</td>
<td>2.20 (1.50–3.21)</td>
</tr>
<tr>
<td><strong>Household income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$20 000</td>
<td>28.0 (24.2–32.2)§§</td>
<td>1.00</td>
</tr>
<tr>
<td>$20 000–$34 999</td>
<td>29.4 (26.3–32.8)</td>
<td>1.03 (0.78–1.34)</td>
</tr>
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<td>$35 000–$49 999</td>
<td>28.6 (25.2–32.4)</td>
<td>0.95 (0.71–1.27)</td>
</tr>
<tr>
<td>$50 000–$74 999</td>
<td>34.7 (31.1–38.5)</td>
<td>1.19 (0.88–1.59)</td>
</tr>
<tr>
<td>≥$75 000</td>
<td>40.1 (36.7–43.6)</td>
<td>1.40 (1.04–1.88)</td>
</tr>
</tbody>
</table>

*Responded “yes” to the question, “Have you heard of a new clot-busting drug that can be used to treat some persons who have had a stroke? This drug is also called tPA.”
†Results of multiple logistic regression with tPA awareness as the dependent variable and age categories, sex, race, education, and household income as independent variables.
‡Statistically significant overall chi-square test \( P < 0.05 \).
§Statistically significant linear test for trend \( P < 0.05 \).
|§Statistically significant Wald F test \( P < 0.05 \).
higher than that in Cincinnati (19%).10 Although all 4 surveys used random-digit-dial telephone methods, there were differences in time periods, populations surveyed, and question structure. We compared the socio-demographic characteristics, ie, age, race, gender, income, and education, among the 4 surveyed populations and found that race was the only variable that varied to any significant degree, with a higher proportion of Hispanics in Texas and a higher proportion of blacks in Cincinnati. However, these racial differences were not sufficient to explain the widely different estimates across the 4 surveys. Differences in question structure and format are the most likely explanations for the wide survey differences, because each survey used different question wording and formats. For example, the survey of U.S. women used a true/false question format, whereas the Cincinnati survey like our study used a question that directly assessed awareness of tPA.

Blacks suffer a higher burden from stroke including greater incidence, stroke severity, and mortality.14 Racial disparities were observed in our results for both awareness of tPA and of the treatment time window; only 7% of black Michigan adults were aware of tPA and its time window, compared with 18% of whites. Several other studies of knowledge of stroke risk factors and warning signs also show consistent racial disparities.8,9,13,14 Similar to prior reports on knowledge of stroke risk factors and warning signs, we also found that tPA awareness was lower in the oldest age groups who are at the greatest risk of stroke.7

Limitations of this study include those associated with the Behavioral Risk Factor Survey and other random digit dial surveys.11 This may include bias attributable to noncoverage (exclusion of people that do not live in private residences or do not have landline phones) and nonresponse. It is also possible that our question wording might have resulted in an overly-optimistic estimate of tPA knowledge. We specifically identified tPA in the first question (instead of leaving the medication vague), and in the follow-up question we indicated that the time window was in hours.

Our results support the inclusion of information about acute stroke treatment, specifically tPA, in public educational campaigns designed to improve stroke knowledge.12 The dominant focus of these public education campaigns has been to improve the awareness of stroke warning signs, rather than the awareness of tPA treatment per se. Educational efforts have been shown to be effective in Michigan in increasing the awareness of stroke warning signs,13 and there is evidence that sustained stroke education campaigns can impact emergency department visits for stroke.15 Although a large number of studies have reported on the awareness of stroke warning signs from a public health perspective, the monitoring of the awareness of tPA as a treatment for acute stroke is equally important because its availability is the primary reason for stroke patients to arrive as early as possible to the hospital.2 It is likely that placing greater emphasis on increasing the public’s awareness of tPA treatment, in addition to their awareness of stroke warning signs, could result in better patient response and earlier arrival times. Finally, based on the variation in tPA awareness found in the literature, we recommend that knowledge of tPA be monitored using a
consistent question format, and that other states consider adding these questions to their BRFSS, so that state-level comparisons can be made.

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Disclosures
None.

References
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