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Development and Validation of the Stroke Action Test

Susan Billings-Gagliardi, PhD; Kathleen M. Mazor, EdD

Background and Purpose—Accurately assessing the public’s readiness to respond to stroke is important. Most published measures are based on recall or recognition of stroke symptoms, or knowledge of the best action for stroke when the diagnosis is provided. The purpose of this study was to develop and evaluate a new written instrument whose items require the respondent to associate individual symptoms with the most appropriate action.

Methods—The Stroke Action Test (STAT) contains 21 items that name or describe stroke symptoms from all 5 groups of warning signs and 7 items that are nonstroke symptoms. For each item, the respondent selects 1 of 4 options: call 911, call doctor, wait 1 hour, or wait 1 day. The instrument validation sample included 249 subjects from community-based organizations. Score reliability and validity were analyzed using multiple data and information sources.

Results—The mean overall STAT score (all 28 items) for the lay people was 36.8%. On average, they chose call 911 for 34.1% of the stroke symptoms. They chose call doctor for 39.4% of the stroke symptoms, wait 1 hour for 20.1%, and wait 1 day for 6.0%. Score reliability is good (α=0.83). Evidence confirming score validity is presented based on analysis of item content and response patterns, and examination of the relationships between test scores and key variables related to stroke knowledge.

Conclusions—STAT directly assesses a critical aspect of practical stroke knowledge that has been largely overlooked and provides scores with good reliability and validity. (Stroke. 2005;36:1035-1039.)

Key Words: reproducibility of results ■ stroke ■ stroke assessment ■ survey instrument

To receive effective stroke therapy, lay people need to quickly access emergency medical services when early symptoms occur.1,2 Accurately assessing this critical component of stroke knowledge is important for epidemiological research and for evaluating the effects of public education programs. The ultimate and most meaningful “test” is the behavior of patients and witnesses during actual strokes.3,4 The challenge for researchers is to develop more practical assessments of this behavior, and to provide evidence of score validity.5–7 In this context, validity evidence consists of information and data supporting the argument that assessment scores predict the actions that lay people would take if a stroke occurs.

Most recent assessments of stroke warning sign knowledge in English-speaking countries use recall tasks, in which respondents named as many warning signs of stroke as they could,8–15 recognition tasks, in which respondents selected all stroke warning signs from short lists,16–18 or responses to a general question such as, “What would you do first if you or a family member were having a stroke?” using an open-ended9–12,15,16 or multiple-choice17 format. However, the content of these assessments is not directly related to the task facing a person in an actual stroke situation. During a stroke, symptoms are experienced or observed. Identification of a symptom as a stroke warning sign is of limited value unless identification leads to urgent action. A person may know that a 911 call is the best response to stroke when the diagnosis is provided, but may not know to call 911 when a stroke symptom presents.11 All of these factors confound interpretation of data that the assessments produce.

The purpose of this study was to develop and evaluate the Stroke Action Test (STAT), a new written instrument whose items require the respondent to associate a symptom with the most appropriate action. To investigate the validity of STAT scores, evidence was collected concerning item content (eg, do items approximate the task being measured, is the most important content emphasized, do examinees understand what is being asked, is the range of possible responses appropriate), reliability of scores, and relationship of scores to previously well-studied variables such as education, stroke experience, or reports of actual stroke situations.

Materials and Methods

STAT Content and Scoring

Content of the STAT is based on the consensus statement about stroke warning signs that major US organizations have agreed to use in their public education materials on stroke.19–21 Using this statement as the framework, items were written by a neuroscientist and a psychometrician, and reviewed by a neurologist. The draft instrument was refined through an iterative process that included think-aloud interviews with lay people to test comprehension and wording,
score validation by clinicians, and pilot testing of the written form. The version of STAT evaluated in this study contains 28 items that name or describe a symptom. For each item, the task of the respondent is to answer the question, “If this happened to you or an adult friend/relative, what would you do?” by selecting 1 of 4 response options: (1) call 911 immediately; (2) call doctor’s office immediately; (3) wait 1 hour and then decide; or (4) wait 1 day and then decide (Table 1). For scoring purposes, each correct response receives 1 point; incorrect responses receive 0 points. The total score is reported as percent of correct responses. Tests are either hand-scored or computer-scored after the answer sheet is scanned.

STAT items include 21 stroke symptoms representing all 5 groups of warning signs, as well as 7 nonstroke symptoms. Eleven items involve sudden unilateral numbness or weakness of the face, arm or leg, or trouble speaking or understanding. Two items contain a common stroke syndrome (e.g., sudden right-side weakness of the face and arm, together with trouble speaking). The 7 nonstroke symptoms represent both urgent and nonurgent medical conditions. The overall SMOG Readability Index of the items is grade 7.22 The complete STAT instrument can be accessed online at http://www.umassmed.edu/entities/cellbio/stat.cfm.

Additional Study Features Providing Data on Score Validity
To allow examination of the effect of item language on STAT scores, symptoms were presented in terse medical language (for the stroke symptoms, quotations from the consensus statement on stroke warning signs), or in lay language, based on descriptions given by lay people who had personally experienced or observed that symptom. For direct comparisons, 8 stroke symptoms were presented in both medical and lay language. To facilitate investigation of the STAT question format itself, 28 supplemental questions presented the same content but required only that the examinee decide whether a symptom was a stroke warning sign. To allow investigation of whether knowledge of the appropriate response to stroke (diagnosis provided) is equivalent to knowledge of the appropriate response to stroke symptoms, examinees were also asked to respond to the statement, “The first thing to do if you think you are having a stroke is to call 911,” by selecting 1 of 5 options, ranging from strongly agree to strongly disagree.

Instrument Validation Sample
Two hundred forty-nine examinees were recruited from community-based organizations in Central Massachusetts. Criteria for inclusion were ages 25 to 75, self-assessed ability to read English, and lack of professional medical training. Examinees took the STAT in a witnessed small-group setting. Time to complete the test was observed, but no time limit was set. Examinees also provided demographic information, rated their overall health, and reported their level of experience with stroke. For this study, experience with stroke was coded as “yes” or “no,” in which “yes” was defined as any personal interactions with individuals who had strokes. Participants received a $7 stipend. To allow investigation of the effects of stroke training on scores, a group of first-year medical student (MS1) volunteers took STAT before (n=93) and after (n=72) 10 hours of instruction in stroke prevention and recognition.23 The study received exempt status from the Institutional Review Board at the University of Massachusetts Medical School.

Table 1. Characteristics of Lay People (n=249)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Lay People Mean (SD) or %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>43.9 (12.0) (range 25–75)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>50.8</td>
</tr>
<tr>
<td>Female</td>
<td>49.2</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White (non-Hispanic)</td>
<td>45.2</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>27.4</td>
</tr>
<tr>
<td>Black or African American</td>
<td>19.4</td>
</tr>
<tr>
<td>Asian</td>
<td>2.0</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>1.6</td>
</tr>
<tr>
<td>Other or unreported</td>
<td>4.4</td>
</tr>
<tr>
<td>Education (highest level achieved)</td>
<td></td>
</tr>
<tr>
<td>Less than high school graduation</td>
<td>18.5</td>
</tr>
<tr>
<td>High school or GED</td>
<td>27.8</td>
</tr>
<tr>
<td>Some college or 2-y degree</td>
<td>27.8</td>
</tr>
<tr>
<td>College graduate</td>
<td>25.8</td>
</tr>
<tr>
<td>Overall health (self-assessed)</td>
<td></td>
</tr>
<tr>
<td>Excellent to very good</td>
<td>49.6</td>
</tr>
<tr>
<td>Good</td>
<td>35.0</td>
</tr>
<tr>
<td>Fair to poor</td>
<td>15.4</td>
</tr>
<tr>
<td>Personal experiences with stroke</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>49.6</td>
</tr>
<tr>
<td>No</td>
<td>50.4</td>
</tr>
</tbody>
</table>

Analyses
Descriptive statistics were used to summarize the characteristics of subjects, mean item and test scores, and frequencies with which they chose each response option. Reliability of test scores was evaluated using Cronbach α. To gather additional validity evidence, scores of subgroups of examinees and of MS1 before and after stroke instruction were compared (t tests and paired t tests). The possible effect of item language on scores was evaluated by calculating the proportion of lay people correctly answering equivalent items that named a symptom in medical language or described the symptom in lay language (see Table 1). Results were compared using McNemar χ² tests.

Results
Demographic characteristics, self-reported health, and personal stroke experiences of the 249 lay people in the instrument validation sample are summarized in Table 2. The majority of examinees completed the 28-item STAT in ≈5 minutes; almost no one took >10 minutes. The mean overall STAT score (based on all 28 items) for these lay people was 36.8%. The mean score on the 21 items containing stroke symptoms was 34.1%. This means that on average, participants in this study chose call 911 for 34.1% of the stroke
symptoms. They chose call doctor for 39.4% of the stroke symptoms, wait 1 hour for 20.1%, and wait 1 day for 6.0%.

To investigate how examinees were using the different response options, we counted the number of times an individual chose each of the 4 options; 24.9% (62 individuals) chose call 911 for ≥2 of the stroke symptoms. Only 4.8% (12 individuals) chose call 911 for ≥16 of the stroke symptoms. Only 10% (25 individuals) chose call doctor for ≥16 of the stroke symptoms, only 1.2% (3 individuals) chose wait 1 hour, and only 0.4% (1 individual) chose wait 1 day. The latter result indicates that examinees tended to distribute their responses across the 3 incorrect options rather than consistently selecting the same incorrect response.

The stroke symptoms for which the fewest of the examinees would call 911 were sudden dizziness, sudden trouble seeing in one eye, and a transient visual loss. The symptoms for which the highest percentage would call 911 were sudden face and arm weakness that presented together with trouble speaking.

The reliability of the 28-item test was good (α=0.83). Investigations of score validity included comparing mean STAT scores across subgroups of examinees. As Table 3 shows, STAT differentiated individuals with different levels of education and stroke training or experience, as would be expected. MS1s without training scored higher than lay people; lay people who reported personal stroke experiences scored higher than lay people without them; and lay people who were college graduates scored higher than lay people who were not. In addition, scores of the same individuals (MS1s) were significantly increased by intense instruction included then there would be only a single correct answer: ambulance.”

For each symptom, the language producing higher scores (P<0.01) is designated by ↑.

Discussion

The STAT is a new written instrument designed to assess lay people’s knowledge of the correct response to individual stroke symptoms. Most lay people complete the test in ≤5 to 7 minutes, and it can be easily scored. The reliability of STAT scores, as estimated by the Cronbach α coefficient, is good. Data and information presented in Results also provide evidence that STAT scores are likely to reflect knowledge of the correct action to take if stroke occurs. This validity evidence is as follows.

First, STAT contains 28 items. The symptoms most often reported in stroke databases are most heavily represented, and all 5 major groups of stroke warning signs are sampled. Seven nonstroke symptoms are included to broaden the range of correct responses, because if only stroke items were included then there would be only a single correct answer: call 911.

Second, there is a logical relationship between the task the test-taker must perform and the underlying behavior that the test seeks to predict: specifically, calling 911 in the event of a stroke. Most previous measures are based on recall or recognition of stroke symptoms, or knowledge of the best action for stroke (diagnosis provided). By contrast, STAT assesses whether the respondent can connect symptoms and appropriate action. The importance of this distinction is underscored by our findings that 94% of examinees agreed that calling 911 is the best response to stroke; yet, on average, only 34% selected call 911 in response to specific symptoms. A similar discrepancy was reported in an epidemiological study.
study of 882 Australian lay people conducted by telephone
interviews.11

Third, STAT items are presented in lay and medical
language, a decision made early in the process of designing
the test in an effort to assure that the majority of test-takers
would understand what was being asked. That decision is
now supported by data showing that scores were higher on
items that described stroke symptoms in lay language than on
items that presented the same symptoms in the medical
language of the consensus statement on stroke warning signs.
We had expected that medical terms and terse style might
increase scores because it would make a symptom appear
more ominous or urgent.26 Because just the opposite oc-
curred, we now hypothesize that some of the examinees did
not recognize the symptom in medical language, or did not
understand what was meant.

Fourth, scores show positive relationships with other vari-
ables reported in the stroke literature. For example, examin-
ees reporting personal experiences with stroke scored higher
on items that presented the same symptoms in the medical
language in acute stroke.28 Finally, as the MS1 data show,
STAT scores are significantly improved by stroke training.

The purpose of this study was to develop and evaluate the
STAT instrument, not to conduct an epidemiological investi-
gation. Our study sample contains individuals with character-
istics that are typical of the population to whom such a test
would likely be administered in the future, including a range
of ethnicities, ages, education, and experience. However, they
are not intended to be a random sample of the US population
at large. That fact acknowledged, it is disturbing that overall
this sample of lay people would call 911 for only 34.1% of
stroke symptoms. They chose an inappropriate response, call
your doctor’s office, more often than they chose call 911.
Looking at the responses of each individual in the sample
provides a different and more alarming perspective. Only
4.8% (12 people) chose call 911 for ≥16 of the 21 stroke
symptoms. Often in testing, we consider 75% or more correct
to be a “passing score.” If we apply that criterion here, then
only ≈5% of our sample “passed.”4

An important limitation of STAT, or any similar instru-
ment, is that it can replicate only a fraction of what would
actually be experienced by a patient or witness in an actual
stroke situation. We need to continue working on ways to
portray symptoms more realistically, perhaps with the use of
multimedia technology, because this should further increase
the predictive value of test scores. In the future, it would also
be important to evaluate the instrument for use with groups of
older or less healthy individuals, and to develop and validate
a culturally sensitive Spanish language version.

In summary, STAT directly assesses a critical aspect of
practical stroke knowledge that has been largely overlooked
and provides scores with good reliability and validity. Our
findings also focus attention on the importance of directing
public education to the critical link between individual stroke
symptoms and calling 911, and of using lay and medical
language in describing stroke symptoms to the public. If
STAT were given to a larger, population-based sample,
responses to individual items could help identify which stroke
symptoms lay people are least likely to respond to and permit
more targeted public education efforts. Additionally, use of a
standardized instrument, such as STAT, would greatly facil-
titate cross-study comparisons.

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from the Meyers Primary Care Institute. We thank Nancy M.
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