Calling 911 in Response to Stroke
A Nationwide Study Assessing Definitive Individual Behavior

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Background and Purpose—Stroke treatment is time-dependent, yet no study has systematically examined response to individual stroke symptoms in the general population. This nationwide study identifies which specific factors prompt correct response (calling 911) to stroke.

Methods—Between November and December of 2005, a survey using a 3-stage random-sampling method including area, household, and household member sampling was conducted throughout the Czech Republic. Participants ≥40 years old were personally interviewed via a structured and standardized questionnaire concerning general knowledge and correct response to stroke as assessed by the Stroke Action Test (STAT). Predictors of scoring ≥50% on STAT were identified by multiple regression.

Results—A total of 650 households were contacted, yielding 592 interviews (response rate 91%). Mean age was 58±12, 55% women. Sixty-nine percent thought stroke was serious condition, and 57% thought it could be treated. Also 54% correctly named ≥2 risk factors, and 46% named ≥2 warning signs. Eighteen percent of respondents scored ≥50% on STAT. The predictors of such a score were age (for each 10-year increment, OR 1.4, 95% CI 1.2 to 1.7), secondary school education (OR 1.7, 95% CI 1.1 to 2.6), knowing that stroke is a serious disease (OR 1.8, 95% CI 1.1 to 3.1), and knowing that stroke is treatable (OR 2.0, 95% CI 1.2 to 3.2).

Conclusions—Knowledge about stroke in the Czech Republic was fair, yet response to warning signs was poor. Our study is the first to identify that calling 911 was influenced by knowledge that stroke is a serious and treatable disease and not by recognition of symptoms. (Stroke. 2008;39:1844-1849.)

Key Words: stroke ■ emergency medical services ■ educational campaigns ■ awareness ■ thrombolysis

R ecombinant tissue plasminogen activator (t-PA) has been shown to improve neurological outcome if given within 3 hours of symptom onset in patients with acute ischemic stroke.1 In 2005, 255 patients in the Czech Republic were treated with intravenous t-PA based on data from SITS register.2 This represents only approximately 1% of all ischemic strokes in the Czech population. The late arrival of stroke patients to a hospital is the primary impediment of thrombolytic treatment.3-6 A principal cause of this problem is considered to be the lack of knowledge about stroke risk factors and warning signs. This lack is documented in many countries, namely the United States,7-15 Australia,16 South Korea,17 Canada,18 Ireland,19 Italy,20 Germany,21 Turkey,22 Switzerland,23 and India.24 The recognition of stroke symptoms is meaningless, however, unless it leads to calling 911. Moreover, studies that systematically investigate behavior in response to individual stroke symptoms and its predictors are nonexistent based on a Medline search (for English articles since 1985) with the key words “acute stroke,” “warning signs,” and “emergency medical services.”

Therefore, the goal of our study was to determine the predictors of calling 911 in reaction to stroke symptoms to better understand what prompts correct response. Such data can improve future public awareness campaigns in the industrialized world. We accomplished this in a prospective study that established the baseline knowledge regarding the risk factors, warning signs, and correct response to stroke in a nationwide sample in the Czech Republic, a member of the European Union.

Materials and Methods

A nationwide sample of people was obtained using a random selection of participants for a personal interview within the entire Czech Republic. The Czech Republic has population of ~10 million with a high population density (130 inhabitants/km²).25 There are 38 stroke centers performing thrombolysis.2 The median catchment area for one center is 280 000 citizens (min 180 000, max 590 000).2 A unique phone number (ie, 155) is used to call an ambulance. Czech
legislation mandates that the longest allowable arrival time to the home after calling "911" for an ambulance is 15 minutes. Whenever possible, stroke patients are transferred to the nearest center performing thrombolysis. Participants included in the survey were >40 years old. Excluded participants were doctors, pharmacists, nurses, or employees of the healthcare system. The protocol was approved by a local ethics committee.

We used a 3-stage random-sampling method including: area sampling, household sampling, and household member sampling.\(^{26,27}\) Area sampling was accomplished by systematic random-sampling with equal probability. This means that any town or city had the same probability for selection. For cities with a population of ≥100,000, suburban districts, instead of the entire city, were subject to sampling.

Household sampling was achieved by the random-walk method, in which a random starting point was selected from an area map and prespecified directions were followed by interviewers.\(^{26,27}\) In the case that no respondent was found (eg, no respondent qualified on selected household), alternative strategies were provided (eg, go to next house or apartment on the right) until appropriate respondent was located.\(^{26,27}\)

Household member sampling was achieved using the Kish selection procedure, which is considered a rigorous selection method for epidemiological surveys.\(^{28}\) This procedure numbers separately women and men in each multi-adult household based on their age. Then, depending on the total number of household members, uses 1 of 8 Kish tables to determine the appropriate respondent. Only individuals that fell within the Kish criteria were interviewed. If the selected person were unavailable, another interview was arranged. Interviews were conducted after working hours and on weekends, not to exclude working participants.

Thirty professional interviewers used by the Institute for Analysis of Medical and Pharmaceutical Information (CEGEDIM) conducted the personal interviews between November and December of 2005. To maximize reproducibility, the interviewers were specifically trained to conduct interviews concerning stroke in a uniform way, which was consistently monitored for quality and comparability.

A standardized questionnaire phrased in layman’s terms was used. The questionnaire was pretested for clarity using a sample of 20 people. The questionnaire included 18 open-ended and 28 close-ended questions divided into 6 sections. The first section contained 5 questions regarding general knowledge about stroke. These questions were: What is meant by the term ictus in Czech? Is stroke a serious disease? Can stroke be treated?

The second and the third section concerned knowledge about stroke risk factors and warning signs of stroke considering recall task (spontaneous naming). It asked the respondent to name at least 3 risk factors for stroke and at least 3 symptoms of stroke. If asked, “stroke risk factor” was defined by respondent as something that may increase the chance of developing a stroke.

The fourth section used The Stroke Action Test (STAT), which is a valid and reliable instrument for assessing correct responses to individual stroke symptoms.\(^{29}\) STAT contains 28 close-ended questions in total: 21 items that name or describe stroke warning signs and 7 items that are nonstroke symptoms. For each item, the respondent selects 1 of 4 options: call “911”, call a doctor, wait 1 hour, or wait 1 day. The STAT score represents how many times, on average, the respondent selected the correct answer (call 911) for stroke symptoms (21 questions). The STAT test was translated into Czech and pretested on 20 volunteers for clarity and comprehension.

The fifth section asked for individual sources of knowledge about stroke. The last section obtained demographic characteristics including the presence of risk factors for stroke.

Correct knowledge of stroke risk factors was assessed using the established risk factors:\(^{30}\) hypertension, heart disease, diabetes, smoking, prior transitory ischemic attack or stroke, heavy alcohol use, and hypercholesterolemia. Stroke warning signs were defined according to published material from the American Heart Association: as: (1) sudden numbness or weakness of the face, arm or leg, especially on one side of the body, (2) sudden confusion, trouble speaking or understanding, (3) sudden trouble seeing in one or both eyes, (4) sudden trouble walking, dizziness, loss of balance or coordination, and (5) sudden, severe headache with no known cause. No other signs or symptoms reported by respondents were considered as stroke warning signs.

### Data Analysis and Statistic

The survey data were analyzed with NCSS (version 2004) software. The primary outcome was a STAT score of ≥50%, meaning that respondents chose to call 911 for more than 10 stroke symptoms (out of 21) on the STAT questionnaire. Based on previous research with only 5% respondents scoring ≥75%,\(^{29}\) we chose a ≥50% cut-off as clinically meaningful and as an “adequate STAT-score.” A sample size of 650 interviews was selected based on an assumption of ≥85% response rate and a 20% event rate to achieve ≥20 events per variable.

The univariate regression analysis was used to assess relationships between: demographic data including self-reported history of risk factors, general knowledge about stroke, knowledge of risk factors, warning signs, and sources of information on one side and between an adequate STAT-score on the other side. The odds ratio with 95% confidence limits was estimated and tested by the Wald  χ² test. Parameters with a potential discrimination power with  P<0.10 were then examined for mutual association using standard maximum likelihood  χ² test for ordinal categorical variables. The final set of potential prognostic factors and interaction terms was subjected to the backward stepwise selection algorithm in multivariate logistic regression.\(^{32}\) For the final model, statistical significance was set at  P≤0.05.

### Results

#### Demographics

A total of 650 households were contacted, which ultimately yielded 592 completed interviews (91% minimum response rate) because of 29 refusals, 14 noncontacts, and 15 noneligible cases.

The demographic characteristics of the 592 participants, including self-reported risk factors for stroke, are presented in Table 1. A total of 325 (55%) were women, mean age was 58±12. As the highest achieved education, a total of 66 (11%) had primary school education, 234 (40%) vocational school (11 years), 205 (35%) secondary school, and 87 (15%) university education.

The demographic profile of the study population is similar to the population of the Czech Republic according to the official statistics from “Population and Housing Census in 2001”.\(^{29}\) For example in this census, the distribution of ages 41 to 50, 50 to 59, 60 to 74, and >74 was 31%, 30%, 26%, and 12%, respectively.\(^{25}\) Also according to the census, of people over the age of 40, 11% attended primary school, 44% vocational school, 31% secondary school, and 14% the university.\(^{25}\)

#### General Knowledge About Stroke

Of all respondents, 501 (85%) thought that the brain was the organ affected by stroke and 25 (4%) thought it was the heart. Also, 393 (66%) respondents stated that ictus (the colloquial term meaning “stroke” in Czech) meant the same as “brain infarction”, 27 (5%) confused stroke with a heart attack, and 154 (26%) did not know what ictus was. In addition, 353 (60%) respondents stated that a stroke is caused by an occlusion of a brain artery, 71 (12%) stated another cause (2% trauma, 2% intoxication, 1% stress), and 164 (28%) did not name any cause. Finally, 411 (69%) stated that a stroke is a serious disease and 335 (57%) thought that stroke could be treated.
Knowledge About Stroke Risk Factors

The prevalence of reported stroke risk factors is presented in Table 2. Smoking 257 (43%), obesity 196 (33%), stress 184 (31%), and hypertension 172 (29%) were the most common risk factors identified by the sampled population. Diabetes 27 (5%), vascular diseases 21 (4%), and heart diseases 13 (2%) were recognized by a minority of respondents. Also, 439 (74%) responders correctly named 1 stroke risk factors, 321 (54%) correctly named 2 risk factors, and 112 (19%) correctly named 3 risk factors.

Knowledge of Warning Signs of Stroke

Knowledge of the warning signs of stroke is presented in Table 2. Respondents identified speech problems 221 (37%), sudden unilateral weakness 202 (34%), loss of vision often in 1 eye 130 (22%), and unconsciousness 116 (20%) as the most common symptoms of stroke. Additionally, 462 (78%) responders correctly named 1 warning sign of stroke, 270 (46%) correctly named 2 warning signs of stroke, and 68 (12%) named 3 warning signs of stroke.

STAT Questionnaire

Of all questions concerning stroke symptoms, averaged together: 27% of respondents chose to call 911, 33% chose to call a doctor, 30% would wait 1 hour, and 10% would wait 1 day. In total, 18% of respondents achieved an adequate STAT-score.

In univariate analysis (Table 3), age (for each 10 year increment, OR 1.3, 95% CI 1.1 to 1.6), secondary school education (OR 2.4, 95% CI 1.0 to 5.6), having diabetes (OR 1.7, 95% CI 1.0 to 2.9), knowing that stroke is caused by vessel occlusion (OR 1.6, 95% CI 1.0 to 2.5), knowing that stroke is a serious disease (OR 2.0, 95% CI 1.2 to 3.3), and knowing that stroke can be treated (OR 2.1, 95% CI 1.3 to 3.3) were significantly associated with an adequate STAT-score.

In multivariate analysis (Table 3), age (for each 10 year increment, OR 1.4, 95% CI 1.2 to 1.7), secondary school education (OR 1.7, 95% CI 1.1 to 2.6), knowing that stroke is a serious disease (OR 1.8, 95% CI 1.1 to 3.2), and knowing that stroke can be treated (OR 2.0, 95% CI 1.2 to 3.2) remained significantly associated with an adequate STAT-score.

Forty-four percent of respondents (the highest for any stroke symptom) chose to call 911 in the case of “sudden weakness of the arm and face, especially on one side, together with trouble speaking” as compared to 71% in the case of “chest pain lasting more than a few minutes” (P<0.001).

None of the variables were significantly associated with a STAT-score concerning the 7 nonstroke questions.

Sources of Information

When asked about sources of information regarding stroke, 199 (34%) reported newspapers and magazines as a source of information, 179 (30%) television, 169 (29%) doctors, 35 (6%) radio, and 138 (23%) had no source of information.

When asked what would be the best source to obtain more information about stroke, 261 (44%) of respondents stated brochures and handouts would be the best source of information, 186 (31%) posters in doctors’ offices and waiting rooms,
185 (31%) television, 99 (17%) magazines and newspapers, 39 (7%) radio, and 7 (1%) internet. One-hundred forty-three (24%) of respondents did not see the need for any other information concerning stroke.

### Discussion

Our study is the first to systematically measure behavior patterns and reaction to individual stroke symptoms in the general population. We found that even the most typical stroke symptoms (unilateral weakness and speech impairment) do not prompt more than 50% of people to call 911. Calling 911 was not driven by knowledge of risk factors or warning signs, but rather by knowledge of the seriousness and treatability of stroke.

In previous studies, 68% to 90% of respondents claimed to call 911 or to visit emergency in the case of stroke.\textsuperscript{10–12,16,24} Such figures overestimate real-life response because it has been documented that only 20% to 25% of all stroke patients come to the hospital within 3 hours from symptom onset.\textsuperscript{3,33} Likewise, according to our data, only 18% of respondents had an “adequate reaction” to individual stroke symptoms, which was similar to another community-based study.\textsuperscript{16}

### Table 3. Univariate and Multivariate Analysis for Adequate STAT-Score

<table>
<thead>
<tr>
<th>Source of Information</th>
<th>n</th>
<th>OR (95% CI)</th>
<th>P</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (increment by 10 years)</td>
<td>592</td>
<td>1.3 (1.1 to 1.6)</td>
<td>0.001</td>
<td>1.4 (1.2 to 1.7)</td>
<td>0.001</td>
</tr>
<tr>
<td>Woman</td>
<td>325</td>
<td>1.1 (0.7 to 1.7)</td>
<td>0.610</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary school</td>
<td>66</td>
<td>1.0</td>
<td>NA</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Vocational school</td>
<td>234</td>
<td>1.6 (0.7 to 3.9)</td>
<td>0.261</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Secondary school</td>
<td>205</td>
<td>2.4 (1.0 to 5.6)</td>
<td>0.047</td>
<td>1.7 (1.1 to 2.6)</td>
<td>0.024</td>
</tr>
<tr>
<td>University</td>
<td>87</td>
<td>1.8 (0.7 to 4.6)</td>
<td>0.251</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>369</td>
<td>1.0</td>
<td>NA</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>28</td>
<td>0.8 (0.3 to 2.5)</td>
<td>0.757</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>87</td>
<td>1.3 (0.7 to 2.4)</td>
<td>0.357</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td>108</td>
<td>1.3 (0.8 to 2.2)</td>
<td>0.356</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Personal history of disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>214</td>
<td>1.1 (0.7 to 1.6)</td>
<td>0.816</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>107</td>
<td>0.6 (0.3 to 1.1)</td>
<td>0.105</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>91</td>
<td>1.7 (1.0 to 2.9)</td>
<td>0.042</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Heart disease</td>
<td>77</td>
<td>1.5 (0.8 to 2.7)</td>
<td>0.167</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td>213</td>
<td>0.9 (0.6 to 1.4)</td>
<td>0.689</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Previous stroke</td>
<td>18</td>
<td>0.9 (0.3 to 3.3)</td>
<td>0.904</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Knowledge that...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>... brain is affected by stroke</td>
<td>501</td>
<td>0.9 (0.5 to 1.6)</td>
<td>0.796</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>... ictus means brain infarction</td>
<td>393</td>
<td>1.0 (0.6 to 1.6)</td>
<td>0.959</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>... stroke is caused by vessel occlusion</td>
<td>353</td>
<td>1.6 (1.0 to 2.5)</td>
<td>0.041</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>... stroke is a serious disease</td>
<td>411</td>
<td>2.0 (1.2 to 3.3)</td>
<td>0.010</td>
<td>1.8 (1.1 to 3.1)</td>
<td>0.023</td>
</tr>
<tr>
<td>... stroke can be treated</td>
<td>335</td>
<td>2.1 (1.3 to 3.3)</td>
<td>0.002</td>
<td>2.0 (1.2 to 3.2)</td>
<td>0.004</td>
</tr>
<tr>
<td>Knowledge of ≥1 risk factors</td>
<td>439</td>
<td>1.1 (0.7 to 1.9)</td>
<td>0.600</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Knowledge of ≥2 risk factors</td>
<td>321</td>
<td>1.2 (0.8 to 1.9)</td>
<td>0.380</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Knowledge of ≥3 risk factors</td>
<td>112</td>
<td>1.4 (0.9 to 2.4)</td>
<td>0.159</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Knowledge of ≥1 warning sign</td>
<td>462</td>
<td>0.8 (0.5 to 1.4)</td>
<td>0.445</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Knowledge of ≥2 warning sign</td>
<td>270</td>
<td>1.0 (0.7 to 1.6)</td>
<td>0.811</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Knowledge of ≥3 warning sign</td>
<td>68</td>
<td>1.1 (0.6 to 2.1)</td>
<td>0.751</td>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

185 (31%) television, 99 (17%) magazines and newspapers, 39 (7%) radio, and 7 (1%) internet. One-hundred forty-three (24%) of respondents did not see the need for any other information concerning stroke.
our definition of an “adequate reaction” (a STAT-score >50%) was chosen for pragmatic reasons, it reflects clinical experience that response to stroke symptoms is poor in stroke patients.3,33

Additionally, previous studies based on patients hospitalized for stroke found that knowledge about stroke warning signs had not necessarily led to the correct response.6,9,34–36 Likewise, our study confirms this observation on the general population. This indicates that recognition of stroke was not sufficient enough to prompt neither previous stroke patients nor people in the general population to call 911. A salient aspect of our study, however, is the finding that people who knew that stroke was a serious and treatable disease were about twice as likely to call 911 also. Our study showed that people of advanced age and secondary school education were more likely to call 911 in response to stroke symptoms. This corresponds with the previous finding that stroke patients were more likely to call or to arrive at emergency in response to stroke symptoms if they were older16,35 or had higher education.23,37

Such findings have an important implication for future public awareness campaigns where the seriousness and treatability of stroke, in addition to warning signs, should be emphasized. Additionally, such campaigns should also target all age groups, especially because it has been shown that stroke patients frequently arrive to hospital via involvement of a third person, usually younger family member.36

At the end of 2005, no campaign educating the general public about stroke had been conducted in the Czech Republic. Knowledge about stroke in the Czech Republic was analogous to previous studies: eg, knowledge of brain as the organ affected by stroke was reported by 85% of our respondents, compared to 45% to 91% in other studies.10,16,20,22–24 Also, in our study, 60% of respondents named vessel occlusion as the cause of stroke compared to 28% to 60% in other published studies.24,19,22 Additionally, 78% of our respondents named ≥1 warning signs of stroke compared to 39% to 80% in other studies.8,10–12,16,20,22,24 Finally, 26% of our respondents could not name any risk factor for stroke, which is similar to results (20% to 43%) from many countries.7–9,12,16,21,22,24 Interestingly, stress was incorrectly reported as one of the most important stroke risk factors by 31% of respondents, which was numerically even higher than respondents reporting hypertension (29%). Discouragingly, only 2% of our respondents reported heart disease as the risk factor for a stroke and 5% reported diabetes, which is comparable to data in the United States.8

In our study, mass media, especially newspapers and television, were most often reported as the primary source of information about stroke. The role of doctors was equal to that of television and, in fact, much better than in other surveys.9 Interestingly, most respondents wished to obtain more information through handouts, brochures, or posters. Information preferably through the internet was desired by only 1% of respondents. This may be attributable to less internet use by people over the age of 40.

A potential limitation of this study is the representativeness of the population through the multi-stage sampling method. It is, however, the only feasible method for sampling a large population. In our case (as is in most other cases) a list of households was unavailable for sampling. Therefore, the widely used random-walk method was used.26,27 Moreover, in our study distribution of age and education was very similar to the Czech population based on census data.25

We also preferred to use the personal interview method, instead of telephone interviews, because of the concern of noncoverage bias. In the Czech Republic, lists of telephone numbers consisted of only landlines which are used less often because of growing use of cell phones and internet providers. Also, personal contact is advantageous because of the complexity of the questionnaire, greater reliability, and higher response rate. For example, in our study we achieved 91% response rate, which minimizes the weakness of other types of interview-selection bias.

In conclusion, knowledge regarding stroke in the Czech Republic was comparable to other industrialized countries. Response to individual stroke symptoms was, however, generally poor. This reflects the need for more studies assessing definitive individual behavior, to increase our understanding of what prompts people to call 911. Nonetheless, we identified that age, education, and knowledge of stroke as a serious and treatable disease are important factors in calling 911. Ultimately, our data stake out a new trajectory for further studies and public awareness concerning stroke.

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Disclosures

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References

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