Knowledge of Ischemic Stroke Risk Factors and Warning Signs After a Health Education Program by Medical Students

Eugenio Gutiérrez-Jiménez, MD; Fernando Góngora-Rivera, MD; Héctor R. Martínez, MD, FACP; Juan M. Escamilla-Garza, MD; Héctor Jorge Villarreal, MD; GECEN Investigators

**Background and Purpose**—A delay in recognizing early warning signs (WS) and risk factors (RF) of ischemic stroke causes a delay in treatment. We evaluated knowledge of RF and WS and the impact of an educational program by medical students.

**Methods**—We first surveyed individuals to determine knowledge of WS and RF. Then, after a 6-month education program, knowledge was reassessed. The questionnaire included sociodemographic and comorbidity data. A \( \chi^2 \) and Mann-Whitney \( U \) test, as well as a multivariate logistic regression analysis to determine variables associated with knowledge, were used.

**Results**—We performed 329 baseline and 355 posteducation surveys. Initially, 57.1% mentioned at least 1 RF; this later increased to 65.9%. Mentions of obesity, dyslipidemias, hypertension, and diabetes mellitus increased significantly. With regard to WS, 37.6% mentioned at least 1, which increased to 48.1% who mentioned weakness in 1 limb, in half the body, severe headache, and altered vision. Educational level (OR, 2.53; 95% CI, 1.42–4.53; \( P = 0.001 \)), employment (OR, 1.72; 95% CI, 1.08–2.74; \( P = 0.021 \)), a family history of brain infarction (OR, 2.35; 95% CI, 1.35–4.11; \( P = 0.02 \)), obesity (OR, 1.63; 95% CI, 1.02–2.6; \( P = 0.038 \)), and having received information in the last 6 months (OR, 2.7; 95% CI, 1.51–4.83; \( P = 0.001 \)) were associated with a better understanding of RF and WS.

**Conclusions**—The educational program was cost-effective and had a positive impact on knowledge of RF and WS of ischemic stroke. More education programs are required to improve knowledge of ischemic stroke. *(Stroke. 2011;42: 897-901.)*

**Key Words:** ischemic stroke ■ risk factors ■ warning signs

Ischemic stroke is the leading cause of disability and the third cause of death in the world.\(^1,2\) In Mexico, it represents the fourth cause of death in adults.\(^3,4\)

A delay in recognizing initial clinical manifestations and the risk factors (RF) of an acute ischemic cerebrovascular event results in a delay in medical support for adequate treatment. The American Heart Association,\(^5\) the Mexican Academy of Neurology, and the Mexican Association of Cerebrovascular Disease\(^6\) have emphasized that the most effective way to prevent and obtain timely treatment for ischemic stroke is through identification of RF and early warning signs (WS) by the general public.

In Mexico, knowledge of RF and WS is low,\(^7\) and there are no campaigns to increase it. For this reason, we conducted a survey to assess public knowledge and the short-term impact of a low-cost community education program performed with the support of medical students.

**Materials and Methods**

This research was evaluated and accepted by the Institutional Review Board and Ethics Committee of the School of Medicine and University Hospital of the Autonomous University of Nuevo León. The Student Group Against Neurological Diseases (GECEN, in Spanish) is composed of fourth-year students of the School of Medicine of the Universidad Autónoma de Nuevo León in Monterrey, Mexico, who have started their clinical clerkship. An educational course for the students in cerebrovascular disease (CVD) was performed for 1 month, twice per week. The course included the following issues: (1) general concepts of CVD; (2) risk factors of CVD; (3) signs and symptoms of CVD; (4) treatment of CVD; and so on.

Received July 16, 2010; accepted November 10, 2010.

From the Department of Neurology, Hospital Universitario Dr. José Eleuterio González and School of Medicine, Universidad Autónoma de Nuevo León, Monterrey, México.


Correspondence to Fernando Góngora-Rivera, MD, Departamento de Neurología, Hospital Universitario Dr. José Eleuterio González, Universidad Autónoma de Nuevo León, Av. Francisco I. Madero s/n, Colonia Mitras Centro, Monterrey, Nuevo León, 64460, México. E-mail fernando.gongora@hotmail.com

© 2011 American Heart Association, Inc.

*Stroke* is available at http://stroke.ahajournals.org DOI: 10.1161/STROKEAHA.110.597062
Table 1. Open-Ended Questions for the Evaluation of the Survey

1) Name at least 3 important risk factors for a person having a stroke or what things or circumstances can increase the chance of having a brain attack.
2) For you, what are the most important symptoms or manifestations in a person experiencing a stroke?
3) If you think someone is having a stroke, then what would you do first?
4) How long after a person feels the first symptoms or signs of a brain attack or stroke should he/she receive medical treatment? Where would you take him/her?
5) If you suspect that you are at high risk for this disease, then do you know where you can receive care?

Table 2. Demographic Characteristics and Clinical History of the Surveyed Population

<table>
<thead>
<tr>
<th>Demographic Variables</th>
<th>First Survey, n (%)</th>
<th>Second Survey, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 329</td>
<td>n = 355</td>
</tr>
<tr>
<td>Average age, years (SD)</td>
<td>45 (19.85)</td>
<td>46 (19.27)</td>
</tr>
<tr>
<td>Men</td>
<td>180 (54.7)</td>
<td>145 (40.6%)</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>125 (37.9)</td>
<td>150 (42.3)</td>
</tr>
<tr>
<td>Married</td>
<td>204 (62.1)</td>
<td>205 (57.7)</td>
</tr>
<tr>
<td>Work activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>159 (48.3)</td>
<td>165 (46.5)</td>
</tr>
<tr>
<td>Unemployed*</td>
<td>170 (51.7)</td>
<td>190 (53.5)</td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not study</td>
<td>15 (4.6)</td>
<td>18 (5.0)</td>
</tr>
<tr>
<td>Incomplete elementary</td>
<td>9 (2.7)</td>
<td>12 (3.4)</td>
</tr>
<tr>
<td>Completed elementary</td>
<td>10 (3.0)</td>
<td>24 (6.8)</td>
</tr>
<tr>
<td>Secondary</td>
<td>23 (7.0)</td>
<td>34 (9.6)</td>
</tr>
<tr>
<td>Preparatory, technical level or higher</td>
<td>272 (82.7)</td>
<td>267 (75.2)</td>
</tr>
<tr>
<td>Medical history</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>52 (15.8)</td>
<td>84 (22.81)</td>
</tr>
<tr>
<td>Smoking</td>
<td>87 (26.4)</td>
<td>85 (23.9)</td>
</tr>
<tr>
<td>Alcohol consumption†</td>
<td>132 (40.1)</td>
<td>199 (56.1)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>43 (13.0)</td>
<td>44 (12.4)</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>49 (14.9)</td>
<td>66 (18.6)</td>
</tr>
<tr>
<td>Previous stroke</td>
<td>1 (0.3)</td>
<td>5 (1.4)</td>
</tr>
<tr>
<td>Family history of stroke</td>
<td>97 (29.5)</td>
<td>68 (19.2)</td>
</tr>
<tr>
<td>Body mass index, average (SD)</td>
<td>26.12</td>
<td>26.06</td>
</tr>
<tr>
<td>Overweight‡</td>
<td>164 (49.8)</td>
<td>188 (52.9)</td>
</tr>
</tbody>
</table>

The Mann-Whitney test and a comparison of averages were used.
*Unemployed or retired.
†Alcohol consumption at least once per week.
‡BMI ≥25 kg/m² according to approximate weight and height referred by the respondent.
§P < 0.05.
¶P < 0.01.

The second part of the survey included questions to assess the prevalence of risk factors in the population such as smoking, diabetes, hyperlipidemia, high blood pressure, heart disease, alcoholism, personal and family history of heart disease, obesity, and a sedentary lifestyle. We obtained this information by direct questioning. Also, an approximate calculation of body mass index was performed with the height and weight reported by each respondent. The RF analyzed were age older than 50 years, a family history or personal history of ischemia, hypertension, smoking, diabetes mellitus, glucose intolerance, a high-fat diet, obesity, atherosclerosis, alcoholism, heart disease, myocardial infarction, cardiac arrhythmia, sedentary lifestyle, drug use, and malnutrition. The response with regard to stress was not considered suitable for the analysis of correct responses before and after the educational program. The WS that were taken as correct were difficulty speaking, weakness of a limb or half the body, a loss of sensation in 1 limb or one-half of the body, altered vision, dizziness, severe headache, or uncoordinated gait.

Statistical Analysis
We performed a descriptive analysis of demographic variables and the responses corresponding to RF and WS of ischemic stroke before and after the community education campaign. To determine the variables that were significantly modified (P < 0.05) before and after the community education campaign, we conducted a χ² test and the
Table 3. Differences in the Percentage of Responses About Risk Factors and Warning Signs of Brain Infarction Before and After an Educational Program

<table>
<thead>
<tr>
<th>No. of Correct Responses</th>
<th>Before the Educational Program, n (%)</th>
<th>After the Educational Program, n (%)</th>
<th>( P^* )</th>
<th>( P^† )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \geq 3 )</td>
<td>45 (13.7)</td>
<td>82 (23.1)</td>
<td>0.001</td>
<td>0.011</td>
</tr>
<tr>
<td>( \geq 2 )</td>
<td>103 (31.5)</td>
<td>156 (43.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \geq 1 )</td>
<td>188 (57.1)</td>
<td>234 (65.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>141 (42.9)</td>
<td>121 (34.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warning signs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \geq 3 )</td>
<td>6 (1.8)</td>
<td>21 (5.9)</td>
<td>0.002</td>
<td>0.024</td>
</tr>
<tr>
<td>( \geq 2 )</td>
<td>38 (11.5)</td>
<td>67 (18.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \geq 1 )</td>
<td>124 (37.6)</td>
<td>171 (48.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>205 (62.3)</td>
<td>184 (51.8)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*\( P \), Mann-Whitney \( U \) test.
†\( P \), multivariate analysis adjusted for age, gender, educational level, history of hypertension, cardiovascular disease, alcohol consumption, and a family history of ischemic stroke.

Mann-Whitney \( U \) test for nonparametric values and multivariate logistic regression analysis. To determine if a difference in knowledge among population at high risk and at low risk for ischemic stroke exists, a \( \chi^2 \) test was performed. All analyses were performed using SPSS version 15.

Results

We conducted 329 surveys in the first stage (180 men and 149 women) and 355 questionnaires in the third stage (145 men and 199 women) after the education program; participants had an average age of 45 years (15–90 years). An education equal or greater than high school or a technical level was reported by 82.7% of the respondents. The demographic variables are shown in Table 2.

In the first stage, before the educational program, 57.1% mentioned at least 1 RF and 31.3% mentioned \( \geq 2 \). In the second stage an increase in knowledge was found, with 65.9% mentioning \( \geq 1 \) RF, and 43.9% mentioning \( \geq 2 \) (Table 3). In the first stage, hypertension (30.4%), stress (20.7%), and smoking (13.7%) were the most frequent risk factors mentioned. After the education program, the most frequently mentioned RF were hypertension (39.2%), stress (25.4%), and smoking (16.9%), together with obesity (20.9%) and dyslipidemia (17.7%). The RF with a significant increase were obesity, dyslipidemia, hypertension, and, to a lesser extent, diabetes mellitus (Table 4).

With regard to knowledge of WS, in the first stage 37.6% mentioned at least 1 and 11.55% mentioned \( \geq 2 \). After the educational program, 48.1% mentioned at least 1 WS and 18.9% mentioned \( \geq 2 \) (Table 3). The most frequent WS mentioned by the study population before the education program were severe headache (19.1%) and difficulty speaking (9.1%). After the education program, the most frequent WS mentioned were severe headache (26.5%), difficulty speaking (9.3%), limb weakness (14.4%), and dizziness or vertigo (9.9%). The WS that showed a significant increase between the 2 surveys were limb weakness, weakness in one-half of the body, severe headache, and, to a lesser extent, altered vision (Table 4).

The demographic factors associated with having a better understanding of RF and WS for ischemic stroke were educational level (OR, 2.53; 95% CI, 1.42–4.53; \( P=0.001 \)), employment (OR, 1.72; 95% CI, 1.08–2.74; \( P=0.021 \)), a family history of stroke (OR, 2.35; 95% CI, 1.35–4.11; \( P=0.02 \)), obesity (OR, 1.63; 95% CI, 1.026–2.60; \( P=0.038 \)) and having received information in the past 6 months during the education program by students (OR, 2.70; 95% CI, 1.51–4.83; \( P=0.001 \)). There were no differences in knowledge among populations at high risk and at low risk for ischemic stroke in both surveys (\( P=0.232 \)).

Discussion

Knowing the RF and WS of ischemic stroke is important to reduce the likelihood of having one, and arriving on time to the hospital for timely treatment to reduce neurological damage is also important.
In 2003, we surveyed 330 people in Mexico City to assess knowledge of RF and WS of ischemic stroke. Of the respondents, 66.7% correctly identified at least 1 risk factor, and 12.1% identified ≥3. With regard to knowledge of WS, 36.7% identified at least 1 and 2.1% reported ≥3. These percentages are similar to those obtained in the first stage of our research, which means that knowledge of ischemic stroke in the general population has not increased in >5 years. Although both surveys were conducted in different cities, multifamily housing units in Mexico are home to a population with similar socioeconomic characteristics.

International studies have previously evaluated the knowledge of RF and WS of ischemic stroke, and these also have observed that general knowledge is low8–12 and that it varies according to gender, socioeconomic status, and educational level of the population.13,14 In both surveys, the one in Mexico City and the one in Monterrey, the variables associated with recognition of RF and WS of ischemic stroke were educational level and a family history of ischemic stroke.7

In a similar survey in another Latin American country, Brazil, knowledge of these same RF for stroke was evaluated in 801 people. In this survey, 8.5% did not mention any RF and 39.5% mentioned ≥3. In this population, knowledge was also associated with educational level and age (younger than 40 years).10

The strategy of community talks and distribution of printed documents by medical students to participants increased the knowledge of RF and WS for ischemic stroke 8.8% and 10.5%, respectively. This slight increase in correct answers justifies the educational work performed by medical students at a low cost, allowing the exchange of ideas and answering questions people have about this disease.

The use of mass media greatly increases awareness of the disease and, therefore, recognition of RF and WS of ischemic stroke. For example, a community education program on brain and myocardial infarction doubled knowledge 4 months after delivering information using mass media. This increase in knowledge occurred mainly in young people and in those with a higher education.13

In other countries, educational programs were financially supported by different associations and governments.15–16 In Mexico, there are no mass education campaigns aimed at preventing and identifying clinical warning signs of cerebral ischemia. The population seeks care late because they believe that the disease is not serious or they go to health care centers that do not have the necessary infrastructure, which often delays specialty health care. Ischemic stroke is the leading cause of functional disability in our country and in the world.1–4 Indirect costs caused by neurological deficits are enormous; this justifies investment in community education programs.

Our population comprised a mixed community of older and young adults from a multifamily housing unit that allows a personal experience of a sick relative and not through school or a preventive method of public awareness.

It is important to point out the response of satisfaction on the part of attendees at conferences and in the surveys received. We recognize that the method of education through conferences and printed materials (brochures) impacts a limited group of people, which is why mass media programs on radio or TV would give us better results and encourage people to go to primary prevention programs and request a medical evaluation during the first minutes of cerebral ischemia.

There is no doubt of the importance that education plays in the prevention and timely treatment of disease. Support is needed from government, associations, and companies to design and implement a massive and effective medical education program on ischemic stroke.

In the first phase of the study, 8% of the population rejected participating in the research; meanwhile, in the second phase just 5% refused to participate. We believe that the increment of participation in the second survey was attributable to a better availability of the population.

This study has some limitations. First, the target population lives in a multifamily housing unit and is not representative of the Mexican population; however, the majority of the population from these housing units represents the most common socioeconomic class in the country. Second, the surveys were performed at 2 different times, with double randomization and a global assessment without a personal follow-up. We currently continue surveillance of this community, noting changes brought about with the different campaigns that impact prevention of ischemic stroke and other diseases.

Conclusions

The knowledge of RF and WS of ischemic stroke in our population is scarce. Medical education directed at the community was accepted and knowledge of RF and WS of ischemic stroke increased. Education programs using mass
media to increase awareness and prevention of ischemic stroke must be performed.

Acknowledgments
The authors acknowledge the work of their administrative assistants, Evelyn Machuca, Leticia Romero, Magda Flores, and Wendy González, and the support provided by the Neurology Department in the use of their classrooms for training. The authors also thank Sergio Lozano-Rodriguez, MD, for his help in translating the manuscript. GECEN forms part of GESTIMED (Student Working and Research Groups in Medicine) and thanks to authorities of the School of Medicine for their support in conducting this work.

Sources of Funding
E.G.-J. is supported by a research scholarship at the Department of Neurology, Hospital Universitario Jose Eleuterio González. GECEN is supported by the Coordination of Clinical Research in the Department of Neurology, Hospital Universitario José Eleuterio González, Universidad Autónoma de Nuevo León.

Disclosures
None.

References


Knowledge of Ischemic Stroke Risk Factors and Warning Signs After a Health Education Program by Medical Students
Eugenio Gutiérrez-Jiménez, Fernando Góngora-Rivera, Héctor R. Martínez, Juan M. Escamilla-Garza, Héctor Jorge Villarreal and GECEN Investigators

Stroke. published online March 10, 2011;
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2011 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/early/2011/03/10/STROKEAHA.110.597062

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org//subscriptions/