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Can Mass Media Influence Emergency Department Visits for Stroke?

Corinne Hodgson, MA, MSc; Patrice Lindsay, RN, PhD; Frank Rubini, BA

Background and Purpose—Television advertising has been associated with significant increases in the knowledge of the warning signs of stroke among Ontarians aged 45 and older. However, to date there has been little data on the relationship between knowledge of the warning signs of stroke and behavior.

Methods—Data on presentation to regional and enhanced district stroke center emergency departments were obtained from the Registry of the Canadian Stroke Network for a 31-month period between mid 2003 and the beginning of 2006. Public opinion polling was used to track knowledge of the warning signs of stroke among Ontarians aged 45 and older.

Results—The public's awareness of the warning signs of stroke increased during 2003 to 2005, decreasing in 2006 after a 5-month advertising blackout. There was a significant increase in the mean number of emergency department visits for stroke over the study period. A campaign effect independent of year was observed for total presentations, presentation within 5 hours of last seen normal, and presentation within 2.5 hours. For TIAs there was a strong campaign effect but no change in the number of presentations by year.

Conclusions—Continuous advertising may be required to build and sustain public awareness of the warning signs of stroke. There are many factors that may influence presentation for stroke and awareness of the warning signs may be only one. However, results of this study suggest there may be an important correlation between the advertising and emergency department presentations with stroke, particularly for TIAs. (*Stroke*. 2007;38:2115-2122.)

Key Words: acute care ■ education ■ stroke ■ symptoms

It has been argued that prehospital delay comprises the majority of time from symptom onset to potential treatment, and thus poses a significant barrier to stroke care.^{1,2} Previous data from Ontario, for example, suggests that even in a jurisdiction with organized stroke care, only 27% of patients arrive in an emergency department (ED) within 2 hours of stroke onset.³

A number of factors have been shown to influence time to hospital presentation of stroke patients. They include personal demographics such as age, race/ethnicity, gender, history of stroke or cardiovascular disease, dependence in the activity of daily living, and socioeconomic status;⁴⁻⁹ the number, severity, or duration of stroke symptoms;^{5,8,10-14} mode of transportation (ambulance or emergency medical services transportation being associated with shorter delays);^{3,5,10,14,15-19} and referral patterns (consultation with a general practitioner or family physician can significantly delay presentation).^{8,20}

Based on the theory that awareness of stroke warning signs is needed to ensure individuals recognize and seek immediate medical attention,²¹⁻²³ over the past 2 decades considerable time, money, and efforts have been expended on assessing the level of public knowledge^{21,24-37} and the effect of awareness-building initiatives, including mass media campaigns.^{21,27,39,40} However, research on the relationship between knowledge of

stroke warning signs and time to presentation at hospital remains limited, and the ability of advertising to shorten time to presentation is unclear. In 1992, Alberts et al⁴¹ reported that an educational campaign increased the proportion of patients arriving at a specialist (tertiary) medical facility within 24 hours from 39.2% to 85.5%, and a 2000 study of 259 stroke patients in the Philippines found that failure to recognize symptoms as serious and stroke-related was associated with delayed presentation.⁴² However, in a retrospective study of 241 consecutive patients with TIA in the UK, correct recognition of symptoms (42.2% of patients) was not associated with less delay.⁴³ Other studies have also failed to find a relationship between stroke knowledge and time to presentation.⁴⁴⁻⁴⁶

Looking at another type of acute cardiovascular event, acute myocardial infarction, the evidence to date has also been mixed. Although at least one study has reported that public education or mass media campaigns can increase knowledge and even self-reported intention to call emergency medical services,⁴⁷ there is little or no evidence that they can change behavior when acute myocardial infarction symptoms are experienced.⁴⁸ In Australia, for example, researchers found that despite several National Heart Foundation campaigns there were no significant differences in pre-hospital

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patient delay.⁴⁹ Likewise, in the Rapid Early Action for Coronary Treatment (REACT) Trial, despite the fact that polling showed that adults in the intervention cities were more knowledgeable about what to do in the case of acute myocardial infarction (32.6% said they would call 911 versus 22.8% for the reference population; $P < 0.006$), data collected on ED presentation showed no difference between the 2 populations in delay from symptom onset to hospital arrival.⁵⁰

Between 2003 and 2005, the Heart and Stroke Foundation of Ontario (HSFO) conducted 2 province-wide television advertising campaigns on the warning signs of stroke, targeting adults aged 45 and older. In a report by investigators of the Registry of the Canadian Stroke Network (RCSN), it was stated that the mean number of stroke visits per month and of visits within 2.5 hours of "last seen normal" increased significantly between the 3 months preceding the first television campaign and the 9 months of the campaign itself.⁵¹ As well, the report notes that ED personnel in Ontario stroke centers have reported anecdotes of patients and families saying they came to the hospital because they had seen the television advertisement. However, to date there has been no means of establishing whether the significant investment the HSFO has made in mass media advertising has had a significant effect on the number of presentations for stroke care or the time to presentation. An editorial accompanying the Foundation's previous report on its mass media strategies suggested that an important missing piece was establishing whether improved knowledge translates into larger proportions of patients seeking timely and appropriate acute and preventive stroke care.⁵² In this article, we follow-up on the HSFO's previous research and, using data from the RCSN, address this important issue.

Materials and Methods

Emergency Department Presentations

The RCSN phase 3 is an ongoing prospective database of all consecutive stroke admissions at 9 Ontario regional stroke centers and 2 enhanced district stroke centers. Data collection for the RCSN is performed by specially trained nurse abstractors who prospectively identify eligible patients through reviews of daily ED records and hospital admission logs. Standardized data collection forms with carefully defined fields are used to record patient data. More detailed information on the RCSN methods has been documented in earlier publications.³

Approval of the study was given by the RCSN and 31 months of data were provided for analysis. The data consisted of the number of patients per month who presented at a regional stroke centers or enhanced district stroke centers with stroke or TIA. Patients presented by ambulance, directly as "walk-ins," or by ambulance as transfers from community hospitals.

For this analysis, we looked at 4 categories: (1) total number of ED visits for stroke; (2) presentation within 5 hours of last seen normal; (3) presentation within 2.5 hours of last seen normal; and (4) presentations with a diagnosis of TIA. Numbers were analyzed by year (2003, 2004, and 2005, excluding the 1 month of data from 2006), season (spring=March, April, and May; summer=June, July, and August; autumn=September, October, and November; and winter=December, January, and February), and campaign status (advertising campaign versus no campaign).

Stroke Advertising

With funding from the Ontario Ministry of Health Promotion, the HSFO conducted 2 paid television advertising campaigns on the

warning signs of stroke. The first was from October 2003 to June 2004, and the second was between December 2004 and July 2005. Air time was purchased province-wide during popular, prime-time programming aimed at those aged 45 years and older at media intensities of 1990 gross rating points for the 9 months of the 2003/2004 campaign, and 2515 for the 8 months of the 2005 campaign (generally considered in the industry as moderate intensity). Associated costs were \$1.76 million for the 2003/2004 campaign and \$1.91 million for 2004/2005.

The advertisement used by the HSFO illustrates the key words of the 5 stroke warning signs (weakness, trouble speaking, vision, headache, and dizziness), with an overlaying stamp reading "sudden." It concludes with a call to action in the form of a voiceover encouraging viewers to call 911 or their local emergency number if they experience any of these symptoms.

There was no paid advertising during the period before the first advertising campaign (July to September 2003) or during the 2 "blackout" periods (July to November 2004, after campaign 1, and August 2005 to January 2006, after campaign 2; Figure 1). Throughout the entire 31 months, a low level of unpaid print and television public service announcements was maintained. As public service announcements, this advertising tends to occur during nonprime hours, and although gross rating points are not tracked, they are typically low.

Knowledge of Stroke Warning Signs

Public knowledge of the warning signs of stroke was monitored among Ontarians by means of telephone public opinion polling. The Ipsos Reid Ontario omnibus reaches a cross-sectional sample of 1000 Ontarians stratified by census division and households, selected by a central telephone-sampling program using modified random-digit dialing. Survey data are weighted by age and gender to reflect the actual adult Ontario population according to the most recent Canadian Census data (at that point, the 2001 Census). For a 95% CI, Ipsos Reid estimates the margin of error to be $\approx \pm 3.1\%$.⁵³

For these surveys, the question used in the HSFO's 1999 to 2003 research study of public knowledge of the warning signs of stroke was used: "Can you tell me what warning signs or symptoms people might experience when they have a stroke?"²⁷ After each response, respondents were prompted with: "Can you think of any other warning signs or symptoms people might experience when they have a stroke?" until a maximum of 5 responses were obtained. Only respondents aged 45 and older were questioned, because this is the target audience for the HSFO's media campaign.

Responses were entered into pre-coded categories, of which the correct warning signs, as determined by the Heart and Stroke Foundation, were⁵⁴:

Headache—sudden or severe headache, excluding migraine headaches.

Weakness or paralysis—weakness, numbness, losing feeling, sudden weakness, weakness of one side.

Trouble with speech—sudden difficulty talking or understanding speech, including lay descriptions such as cannot talk or talking gibberish.

Vision problems or trouble seeing, including tunnel vision and double vision.

Dizziness, lightheadedness, or unexplained falls.

Categories were mutually exclusive and no double counting was allowed. For example, a respondent who gave the answers "dizziness" and "unexplained falls" was coded as having only one correct response. Response categories not included in this analysis were "do not know," "other," and incorrect responses such as "chest pain" or "difficulty breathing."

Primary outcome measures were the mean number of warning signs named by respondents, as well as the proportion of respondents who could name ≥ 2 of the correct warning signs. Weighted numbers and percentages are given but all testing (χ^2 with a Yates correction for proportions and ANOVA or t tests for means) was performed on unweighted numbers.

For analysis, education was divided into 4 categories: (1) did not complete high school; (2) completed high school; (3) technical, trade

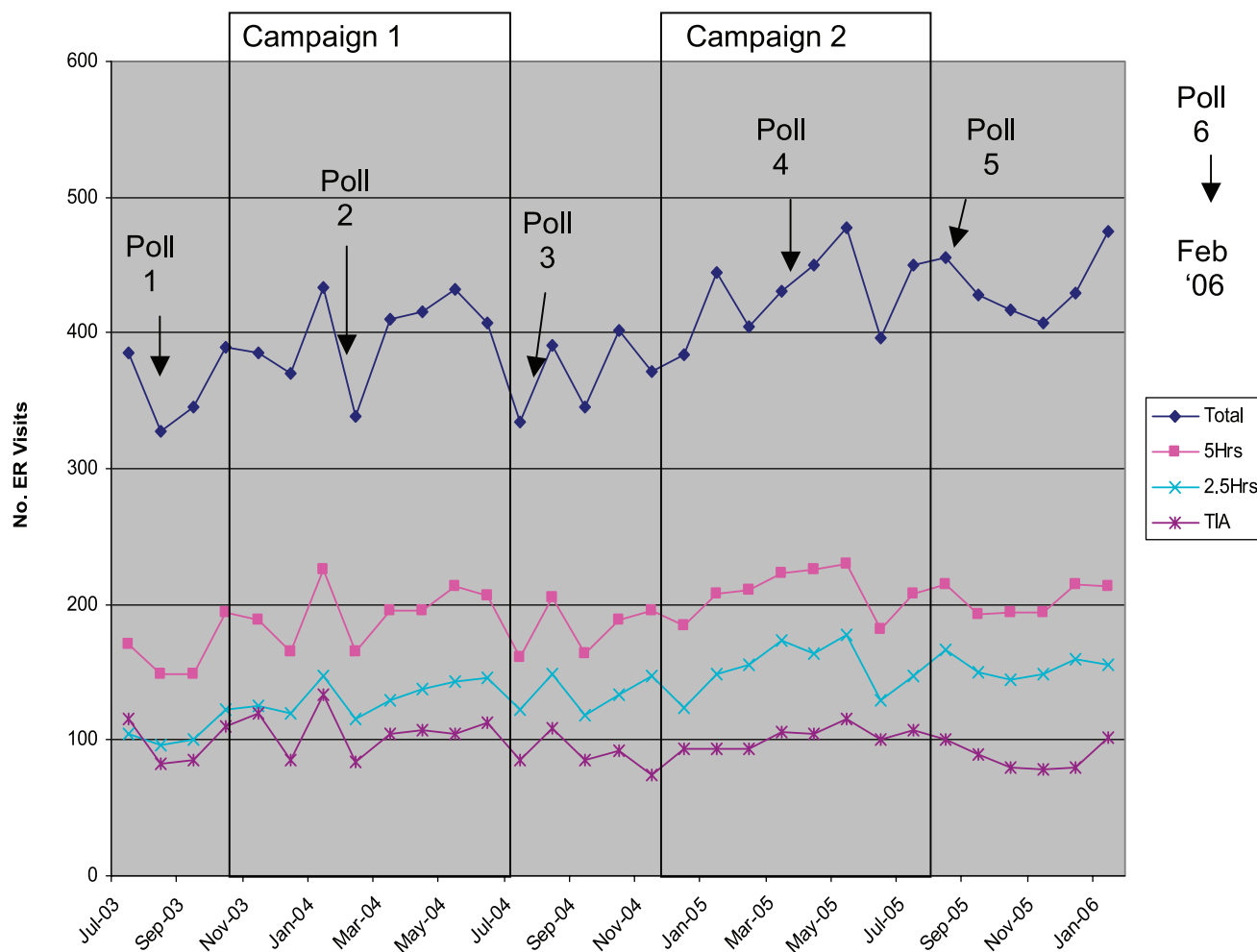


Figure 1. Number of ED visits.

community college, or incomplete university; and (4) completed university (undergraduate and graduate).

Surveys were conducted just before the first advertising campaign (poll 1, August 2003), during, and immediately after the first campaign (poll 2, February 2004; and poll 3, July 2004), during, and in the weeks after the second campaign (poll 4, March 2005; and poll 5, August, 2005), and after the second blackout period (poll 6, February 2006). The last poll is the only one that can be said to represent awareness after several months of no advertising. Each survey was conducted with an independent sample of citizens.

Ethics approval for the study was granted by the Canadian Stroke Network. All data were analyzed using SPSS 14.0 (SPSS, Chicago, Ill).

Results

ED Visits

Over the 31 months, a total of 12 534 ED visits for stroke were recorded, of which 4303 (34.3%) arrived within 2.5 hours of last seen normal and an accumulated total of 6024 (48.1%) within 5 hours. Of all 12 534 presentations, 3040 (24.3%) were identified as TIAs. Figure 1 illustrates the number of ED visits by month, as well as the campaign periods and when polls were conducted.

Table 1 shows data from 2003, 2004, and 2005 (excluding the 1 month of data from 2006), showing mean number of ED presentations for the 4 categories by year and for the campaign and noncampaign months. In regression analysis,

the r^2 for total visits was 0.51 ($P<0.001$) for year, and increased to 0.60 when campaign status was added ($P<0.001$); for 5 hours, the values were 0.41 ($P<0.001$) and 0.56 ($P<0.001$); and for 2.5 hours the values were 0.63 ($P<0.001$) and 0.67 ($P<0.001$). The individual contribution of campaign to the model was thus 0.09 for total visits, 0.15 for visits within 5 hours, and 0.05 for visits within 2.5 hours. For TIAs, the r^2 value was 0.01 ($P=0.671$) for year alone and 0.30 when campaign status was added ($P=0.007$). The individual contribution of campaign status for TIA was 0.29.

The relationship between season and number of ED presentations was also tested with ANOVA. When data from 2003 to 2005 were combined, there was no significant variation by season for any of the categories ($P>0.05$). There was also no significant variation by season in 2003 or 2004 (all $P>0.05$). In 2005, when the second advertising campaign was held during 3 of the 4 seasons, there was significant variation by season for TIAs ($P=0.003$) and presentation within 5 hours ($P=0.013$) but not for the other categories.

Knowledge of Stroke Warning Signs

Table 2 shows the result of the polling data. Between August 2003 and August 2005 there was a consistent increase in the proportion who could name ≥ 2 correct warning signs of

TABLE 1. Mean Number (SD) of Stroke ED Visits by Year and Campaign Status

Year	Campaign Status (no)	Total Visits, Mean (SD)	Within 5 Hours, Mean (SD)	Within 2.5 Hours, Mean (SD)	TIAs, Mean (SD)
2003	Campaign (3)	381.33 (10.02)	182.33 (15.31)	122.67 (2.52)	105.00 (18.03)
	No campaign (3)	353.00 (29.82)	155.33 (12.70)	100.33 (3.51)	94.67 (17.67)
	Both (6)	367.17 (25.23)	168.83 (19.42)	111.50 (12.53)	99.83 (16.94)
2004	Campaign (7)	403.00 (33.22)	198.14 (19.84)	134.71 (12.13)	105.71 (15.34)
	No campaign (5)	368.60 (29.06)	182.60 (19.35)	134.00 (13.34)	89.40 (12.54)
	Both (12)	388.67 (34.97)	191.67 (20.37)	134.42 (12.05)	98.92 (16.00)
2005	Campaign (8)	438.75 (26.68)	212.75 (15.30)	157.75 (15.64)	103.13 (7.34)
	No campaign (4)	420.50 (10.66)	199.00 (10.68)	150.75 (6.50)	81.75 (4.92)
	Both (12)	432.67 (23.77)	208.17 (15.03)	155.42 (13.38)	96.00 (12.31)
Total	Campaign (18)	415.28 (34.92)	202.00 (19.79)	142.94 (18.89)	104.44 (12.04)
	No campaign (12)	382.00 (36.74)	181.25 (22.25)	131.17 (21.93)	88.17 (12.16)
	Both (30)	401.97 (38.75)	193.70 (22.90)	138.23 (20.64)	97.93 (14.38)

stroke ($P<0.001$), as well as the mean number of warning signs ($P<0.001$). The proportion who could not name any warning signs of stroke also decreased from 21.7% in August 2003 to 10.2% in August 2005 ($\chi^2_{(1df)}=54.68$; $P<0.001$).

Between August 2005, the poll immediately after the second campaign, and February 2006, at the end of the blackout period, the proportion who could name ≥ 2 warning signs decreased (from 72.7% to 63.6%; $\chi^2_{(1df)}=20.43$; $P<0.001$), as did the mean number of warning signs correctly named (from 2.30 [1.29] in August 2005 to 1.99 [1.30] in February 2006; t [2133]=5.55; $P<0.001$). There were significant decreases in the proportions who named paralysis ($\chi^2_{(1df)}=4.11$; $P<0.05$), difficulty talking ($\chi^2_{(1df)}=16.60$; $P<0.001$), vision problems ($\chi^2_{(1df)}=20.98$; $P<0.001$), and dizziness ($\chi^2_{(1df)}=11.45$; $P<0.001$).

Figure 2 shows the proportion by gender who could name ≥ 2 correct warning signs of stroke. At all polls, significantly

more women than men were able to name ≥ 2 warning signs of stroke (χ^2 for all comparisons had $P<.001$). Between polls 5 and 6 (ie, after the 5-month blackout period), there were significant decreases for both women (80.5% to 71.2%; $\chi^2_{(1df)}=13.402$; $P<0.001$) and men (63.1% to 56.3%; $\chi^2_{(1df)}=4.836$; $P=0.030$).

For all polls there was no significant variation in the proportion who could name ≥ 2 correct warning signs by age group (for poll 1 the values were 54.0% for the younger and 47.8% for the older age group; poll 2 65.3% and 51.3%; poll 3 69.5% and 66.9%; poll 4 72.0% and 69.5%; poll 5 73.2% and 72.2%; and poll 6 65.2% and 62.0%; all $P>.05$). After the blackout (ie, between polls 5 and 6) there were significant declines for the 45 to 64 age group (from 73.2% to 65.2%; $\chi^2_{(1df)}=10.604$; $P<0.001$) and the 65 and older age group (72.2% to 62.0%; $\chi^2_{(1df)}=6.738$; $P=0.006$).

TABLE 2. Knowledge of Correct Warning Signs of Stroke

	August 2003	February 2004	July 2004	March 2005	August 2005	February 2006
Unweighted, n	1153	1195	1063	1147	1082	1053
Weighted, n	1192	1172	1051	1071	1027	967
Mean (SD)	1.69 (1.27)	1.99 (1.30)	2.15 (1.31)	2.26 (1.30)	2.31 (1.29)	1.99 (1.30)
≥ 2 correct	621 (52.1%)	742 (63.3%)	713 (67.8%)	758 (70.8%)	743 (72.3%)	621 (64.2%)
Signs						
Paralysis	584 (49.0%)	551 (47.0%)	488 (46.4%)	473 (44.1%)	493 (48.0%)	425 (44.0%)
Speech	275 (23.1%)	358 (30.5%)	388 (36.9%)	422 (39.4%)	425 (41.4%)	325 (33.6%)
Headache	343 (28.8%)	380 (32.4%)	355 (33.8%)	383 (35.8%)	328 (31.9%)	304 (31.4%)
Vision	290 (24.3%)	399 (34%)	389 (34.0%)	469 (43.8%)	465 (45.3%)	354 (36.6%)
Dizziness	508 (42.7%)	643 (54.9%)	618 (58.8%)	669 (62.5%)	642 (62.5%)	538 (55.6%)
Number known						
0	259 (21.7%)	176 (15.0%)	152 (14.5%)	120 (11.2%)	105 (10.2%)	149 (15.4%)
1	312 (26.2%)	255 (21.7%)	186 (17.7%)	193 (18.0%)	179 (17.4%)	197 (20.4%)
2	289 (24.2%)	334 (28.4%)	273 (26.0%)	279 (26.1%)	274 (26.7%)	261 (27.0%)
3	232 (19.5%)	253 (21.6%)	275 (26.2%)	280 (26.1%)	285 (27.8%)	233 (24.1%)
4	84 (7.0%)	126 (10.7%)	145 (13.8%)	172 (16.1%)	147 (14.3%)	106 (11.0%)
5	16 (1.3%)	30 (2.6%)	20 (2.5%)	27 (2.5%)	36 (3.5%)	21 (2.2%)

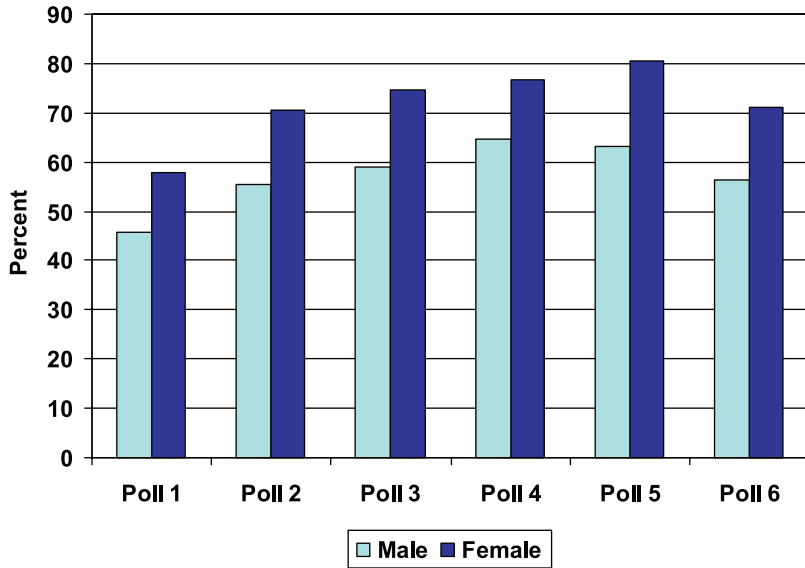


Figure 2. Percent naming ≥2 warning signs of stroke by gender.

Could age in years have a different effect on the ability to name ≥2 warning signs? Logistic regression found that although gender was significant ($P < 0.001$) age in years was not ($P = 0.067$). The analysis was also conducted individually for each poll and results were similar for all 6 (data not shown).

Univariate ANOVAs showed there were statistically significant variation between educational groups in the ability to name ≥2 warning signs at poll 1 (August 2003, $P = 0.028$) and 4 (March 2005, $P = 0.010$), but not for polls 2, 3, 5, and 6 (all $P > .05$; Figure 3). Although there was a decrease between polls 4 and 5 for those with less than a high school education (from 64.4% to 56.7%), it was not significant ($\chi^2_{(1df)} = 1.612$; $P = 0.127$).

Between polls 5 and 6 (the blackout period), the ability to name ≥2 warning signs declined in all education groups. The decline for those with less than high school was not significant (from 56.7% to 44.0%; $\chi^2_{(1df)} = 3.346$; $P = 0.072$), but it was for those with a high school education (72.1% to 61.0%;

$\chi^2_{(1df)} = 5.692$; $P = 0.006$), some technical or college training (75.6% to 64.9%; $\chi^2_{(1df)} = 8.916$; $P = 0.002$), and university education (75.7% versus 68.9%; $\chi^2_{(1df)} = 4.276$; $P = 0.023$).

Discussion

The polling data suggest there is a relationship between mass media advertising and the knowledge of adults about the warning signs of stroke. The HSFO's previous research in 1999 and 2001 found knowledge of stroke warning signs higher among women as opposed to men, those aged 45 to 64 years as opposed to those 65 and older, and those with higher, as opposed to lower, levels of education.²⁷ In the polling conducted between 2003 and 2006, women continued to demonstrate greater knowledge of stroke warning signs than men. Although the differences by age groups and education level trended in a manner similar to that observed earlier, they were no longer statistically significant. This suggests that television advertising may have contributed to a reduction in

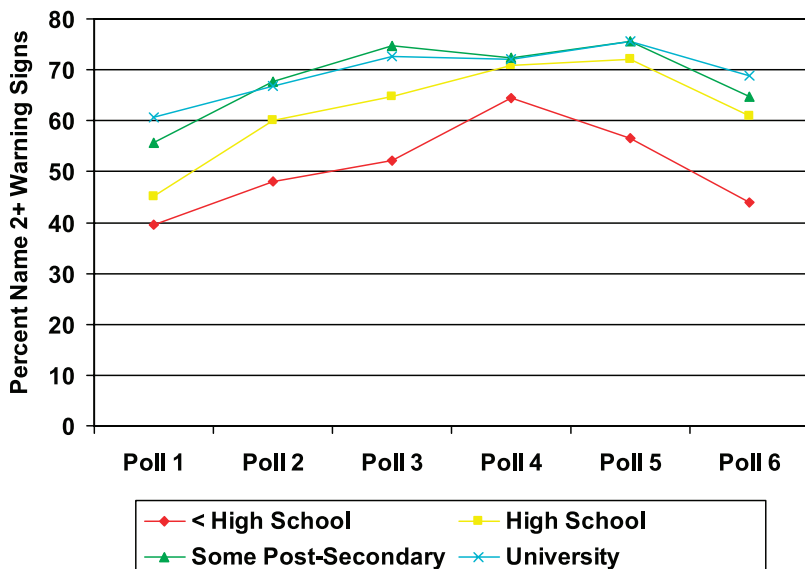


Figure 3. Percent naming ≥2 warning signs of stroke by education.

age and education-related differences in knowledge of the warning signs of stroke.

The results also show that for all segments of society the absence of advertising is associated with significant declines in knowledge. Polling after a 5-month hiatus showed a decrease in knowledge among both sexes, both age categories, and most education groups. Continuity appears to be essential for not only increasing knowledge of the warning signs of stroke but sustaining these gains.

Did the greater knowledge of stroke warning signs associated with the advertising help to drive stroke patients to seek medical care? In most jurisdictions, it would be difficult to address this question outside of the confines of a clinical trial. The situation in Ontario, in which there is a stroke registry and province-wide advertising campaigns of specific duration, presents a unique opportunity. Because our data are at the population level, a direct or causal relationship between the advertising and individual ED presentation cannot be proven. However, the Ontario data has been able to demonstrate that at the population level mass media has a significant effect on ED presentations. For most strokes, the effect is not huge (9% of variance for total visits, 15% for visits within 5 hours, and 5% for visits within 2.5 hours); for TIAs, however, campaign status explained almost 30% of the variance in ED visits. The ability of television advertising to drive people experiencing stroke symptoms, particularly when they are transitory and might otherwise be ignored, is important. ED presentations are not only opportunities for stroke care but also, in the case of TIAs, opportunities for ongoing stroke prevention.

A recent study suggests that the prevalence of stroke symptoms in the general population may be higher than previously suspected, with 17.8% experiencing one or more symptoms.⁵⁵ Our results suggest that sustained television advertising is one means of ensuring such people seek immediate medical attention.

Our results are in keeping with a growing body of evidence suggesting that mass media campaigns can change awareness, knowledge, and even behavior,^{56,57} particularly if campaigns concentrate on single efficacious and clear messages⁵⁸ and have prolonged exposure.⁵⁹ Although some information about stroke may be provided through the news media,⁶⁰ mass media is probably the most feasible means of providing this education at the population level.

A number of factors may influence the rate of stroke presentation in a jurisdiction, such as incidence, case finding rate, and seasonal variations. A previous report from the RSCN found that between 2000 and 2003, the number of stroke presentations increased from 9.9% to 10.3%.⁶¹ A system of organized stroke care, such as implemented across Ontario in 2001, may have also improved the identification of stroke at both the pre-hospital and hospital phase.

The issue of seasonal variations was also addressed, as there have been reports of significant variation from a number of jurisdictions, including Italy,⁶² Finland,⁶³ Japan,⁶⁴ Australia,⁶⁵ and the US.⁶⁶ However, other studies have failed to produce consistent support for this hypothesis.^{67–70} Moreover, it is unlikely that season could have confounded the data presented here, because both advertising campaigns covered

more than one season (late autumn, winter, spring, and early summer for the first campaign, and winter, spring, and most of the summer for the second campaign).

Because this was an observational rather than an experimental study, it is not possible to prove causation. For example, the campaign period could have been contaminated by other sources of stroke information (eg, physicians, the Internet) and the blackout periods by recall of information from earlier advertising campaigns and the low level of continuous public service announcements. To pursue this research further, alternative methods may be required, such as using a control group or querying stroke patients or their families about their recall of the stroke advertisement or their television viewing habits (although validating the accuracy of such data would be difficult). Despite these problems, this study provides the best data to date on the utility of funding public education campaigns on the warning signs of stroke. Although the effects may be small, it suggests that significant benefits can be expected, particularly for TIAs. Based on these results, the HSFO is planning to continue its mass media strategy and is considering new approaches to optimize its impact.

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Disclosures

None.

References

1. Evenson KR, Rosamond WD, Morris DL. Prehospital and in-hospital delays in acute stroke care. *Neuroepidemiology*. 2001;20:65–76.
2. Pittock SJ, Meldrum D, Hardiman O, Deane C, Dunne P, Hussey A, Gorman M, Moroney JT. Patient and hospital delays in acute ischaemic stroke in a Dublin teaching hospital. *Ir Med*. 2003;96:167–168, 170–171.
3. Kapral MK, Fang J, Hill MD, Silver F, Richards J, Jaigobin C, Cheung AM for the Investigators of the Registry of the Canadian Stroke Network. Sex differences in stroke care and outcomes. Results from the Registry of the Canadian Stroke Network. *Stroke*. 2005;36:809–814.
4. Lacy CR, Suh DC, Bueno M, Kostis JB. Delay in presentation and evaluation for acute stroke: Stroke Time Registry for Outcomes Knowledge and Epidemiology (S.T.R.O.K.E.). *Stroke*. 2001;32:63–69.
5. Rossmagel K, Jungelhulsing GJ, Nolte CH, Muller-Nordhorn J, Roll S, Wegscheider K, Villringer A, Willich SN. Out-of-hospital delays in patients with acute stroke. *Ann Emerg Med*. 2004;44:476–483.
6. Barr J, McKinley S, O'Brien E, Herkes G. Patient recognition of and response to symptoms of TIA or stroke. *Neuroepidemiology*. 2006;26:168–175.
7. Kleindorfer DO, Lindsell CJ, Broderick JP, Flaherty ML, Woo D, Ewing I, Schmit P, Moomaw C, Alwell K, Pancioli A, Jauch E, Khoury J, Milel R, Schneider A, Kissela BM. Community socioeconomic status and prehospital times in acute stroke and transient ischemic attack. Do poorer patients have longer delays from 911 call to the emergency department. *Stroke*. 2006;37:1508–1513.
8. Mandelzweig L, Goldbourt U, Boyko V, Tanne D. Perceptual, social, and behavioral factors associated with delays in seeking medical care in patients with symptoms of acute stroke. *Stroke*. 2006;37:1248–1253.
9. Smith MA, Doliszny KM, Shahar E, McGovern PG, Arnett DK, Luepker RV. Delayed hospital arrival for acute stroke: the Minnesota Stroke Survey. *Ann Intern Med*. 1998;129:190–196.
10. Wester P, Radberg J, Lundgren B, Peltonen M. Factors associated with delayed admission to hospital and in-hospital delays in acute stroke and TIA: a prospective, multicenter study. *Stroke*. 1999;30:40–48.

11. Casetta I, Granieri E, Gilli G, Lauria G, Tola MR, Paolino E. Temporal trend and factors associated with delayed hospital admission of stroke patients. *Neuroepidemiology*. 1999;18:255–264.
12. Azzimondi G, Bassein L, Fiorani L, Nonino F, Montaguti U, Celin D, Re G, D'Alessandro R. Variables associated with hospital arrival time after stroke: effect of delay on the clinical efficiency of early treatment. *Stroke*. 1997;28:537–542.
13. Feldmann E, Gordon N, Brooks JM, Brass LM, Fayad PB, Sawaya KL, Nazareno F, Levine SR. Factors associated with early presentation of acute stroke. *Stroke*. 1993;24:1805–1810.
14. Derex L, Adelein P, Nighoghossian N, Honnorat J, Trouillas P. Factors influencing early admission in a French stroke unit. *Stroke*. 2002;33:153–159.
15. Morris DL, Rosamond W, Madden K, Schultz C, Hamilton S. Prehospital and emergency department delays after acute stroke: the Genetech Stroke Presentation Survey. *Stroke*. 2000;31:2585–2590.
16. Agyeman O, Nedeltchev K, Arnold M, Fischer U, Remonda L, Isenegger J, Schroth G, Mattle HP. Time to admission in acute ischemic stroke and transient ischemic attack. *Stroke*. 2006;37:963–966.
17. Harraf F, Sharma AK, Brown MM, Lees KR, Vass RI, Kalra L. A multicenter observational study of presentation and early assessment of acute stroke. *BMJ*. 2002;325:17.
18. Morris DL, Rosamond WD, Hinn AR, Gorton RA. Time delays in accessing stroke care in the emergency department. *Acad Emerg Med*. 1999;6:218–223.
19. Rosamond WD, Gorton RA, Hinn AR, Hohenhaus SM, Morris DL. Rapid response to stroke symptoms: the Delay in Accessing Stroke Healthcare (DASH) study. *Acad Emerg Med*. 1998;5:45–51.
20. Fogelholm R, Murros K, Rissanen, Ilmavirta M. Factors delaying hospital admission after acute stroke. *Stroke*. 1996;27:398–400.
21. Brice JH, Griswell JK, Delbridge TR, Key CB. Stroke: from recognition by the public to management by emergency medical services. *Prehosp Emerg Care*. 2002;6:99–106.
22. Kothari R, Sauerbeck L, Jauch E, Broderick J, Brott T, Khoury J, Liu T. Patients' awareness of stroke signs, symptoms, and risk factors. *Stroke*. 1997;28:1871–1875.
23. King DF, Trouth AJ, Adams AO. Factors preventing African Americans from seeking early intervention in the treatment of ischemic strokes. *J Nat Med Assoc*. 2001;93:43–46.
24. Muller-Nordhorn J, Nolte CH, Rossmagel K, Jungelhulsing GJ, Reich A, Roll S, Villringer A, Willich SN. Knowledge about risk factors for stroke. A population-based survey with 28090 participants. *Stroke*. 2006;37:946–950.
25. Reeves MJ, Hogan JG, Rafferty AP. Knowledge of stroke risk factors and warning signs among Michigan adults. *Neurology*. 2002;59:1547–1552.
26. Yoon SS, Heller RF, Levi C, Wiggers J, Fitzgerald PE. Knowledge of stroke risk factors, warning symptoms, and treatment among an Australian urban population. *Stroke*. 2001;32:1926–1930.
27. Silver FL, Rubini F, Black D, Hodgson CS. Advertising strategies to increase public knowledge of the warning signs of stroke. *Stroke*. 2003;34:1965–1968.
28. Pancioli AM, Broderick J, Kothari R, Brott T, Tuchfarber A, Miller R, Khoury J, Jauch E. Public perception of stroke warning signs and knowledge of potential risk factors. *JAMA*. 1998;279:1288–1292.
29. Schneider AT, Pancioli AM, Khoury JC, Rademacher E, Tuchfarber A, Miller R, Woo D, Kissela B, Broderick JP. Trends in community knowledge of the warning signs and risk factors for stroke. *JAMA*. 2003;289:343–346.
30. Ferris A, Robertson RM, Fabunmi R, Mosca L. American Heart Association and American Stroke Association national survey of stroke risk awareness among women. *Circulation*. 2005;111:1321–1326.
31. Alkadry MG, Wilson C, Nicholson D. Stroke awareness among rural residents: the case of West Virginia. *Soc Work Health Care*. 2005;42:73–92.
32. Blades LL, Oser CS, Dietrich DW, Okon NJ, Rodriguez DV, Burnett AM, Russell JA, Allen MJ, Fogle CC, Helgeson SD, Gohdes D, Harwell TS. Rural community knowledge of stroke warning signs and risk factors. *Prev Chronic Dis* 2005;2:A14 epub 2005 March 15.
33. Greenlund KJ, Neff LJ, Zheng ZJ, Keenan NL, Giles WH, Ayala CA, Croft JB, Mensah GA. Low public recognition of major stroke symptoms. *Am J Prev Med*. 2003;25:315–319.
34. Morgan LJ, Chambers R, Banerji J, Gater J, Jordan J. Consumers leading public consultation: the general public's knowledge of stroke. *Fam Pract*. 2005;22:8–14.
35. Hwang SY, Zerwic JJ. Knowledge of stroke symptoms and risk factors among Korean immigrants in the United States. *Res Nurs Health*. 2006;29:337–344.
36. De Dominicis L, Cardinali P, Pucci E, Marchegiani G, Caporalini R, Moretti V, Sanguigni S, Carle F, Gesuita R, Giuliani G. What do Italians at high risk of stroke know about ischemic stroke? A survey among a group of subjects undergoing neuro-sonographic examination. *Neurol Sci*. 2006;27:7–13.
37. Segura T, Vega G, Lopez S, Rubio F, Castillo J. Public perception of stroke in Spain. *Cerebrovasc Dis* 2003;16:21–26.
38. Stern EB, Berman M, Thomas JJ, Klassen AC. Community education for stroke awareness: an efficacy study. *Stroke*. 1999;30:720–723.
39. Becker K, Fruin M, Gooding T, Tirschwell D, Love P, Mankowski T. Community-based education improves stroke knowledge. *Cerebrovasc Dis*. 2001;11:34–43.
40. DeLemos CD, Atkinson RP, Croopnick SL, Wentworth DA, Akins PT. How effective are "community" stroke screening programs at improving stroke knowledge and prevention practices? Results of a 3-month follow-up study. *Stroke*. 2003;34:e247–e249.
41. Alberts MJ, Perry A, Dawson DV, Bertels C. Effects of public and professional education on reducing the delay in presentation and referral of stroke patients. *Stroke* 1992;23:352–356.
42. Yu RF, San Jose MC, Manzanilla BM, Oris MY, Gan R. Sources and reasons for delays in the care of acute stroke patients. *J Neurol Sci*. 2002;199:49–54.
43. Giles MF, Flossman E, Rothwell PM. Patient behavior immediately after transient ischemic attack according to clinical characteristics, perception of the event, and predicted risk of stroke. *Stroke*. 2006;37:1254–1260.
44. Williams LS, Bruno A, Rouch D, Marriott DJ. Stroke patients' knowledge of stroke. Influence on time to presentation. *Stroke*. 1997;28:912–915.
45. Cheung RT. Hong Kong patients' knowledge of stroke does not influence time-to-hospital presentation. *J Clin Neurosci*. 2001;8:311–314.
46. Carroll C, Hobart J, Fox C, Teare L, Gibson J. Stroke in Devon: knowledge was good, but action was poor. *J Neurol Neurosurg Psychiatry*. 2004;75:567–571.
47. Brown AL, Mann C, Daya M, Goldberg R, Meischke H, Taylor J, Smith K, Osganian S, Cooper L for the Rapid Early Action of Coronary Treatment (REACT) Study. Demographic, belief, and situational factors influencing the decision to utilize emergency medical services among chest pain patients. *Circulation*. 2000;102:173–178.
48. Caldwell MA, Miasowski C. Mass media interventions to reduce help-seeking delay in people with symptoms of acute myocardial infarction: time for a new approach. *Patient Educ Couns*. 2002;46:1–9.
49. Bett JH, Tonkin AM, Thompson PL, Aroney CN. Failure of current public educational campaigns to impact on the initial response of patients with possible heart attack. *Intern Med J*. 2005;35:279–282.
50. Luepker RV, Raczynski JM, Osganian S, Goldberg RJ, Finnegan JR Jr, Hedges JR, Goff DC et al. for the REACT Study Group. Effect of a community intervention on patient delay and emergency medical service use in acute coronary heart disease. The Rapid Early Action for Coronary Treatment (REACT) Trial. *JAMA* 284:60–67.
51. Lindsay MP, Kapral MK, Fang J, Robertson A, Silver FS on behalf of the Investigators of the Registry of the Canadian Stroke Network. Stroke Performance Indicator Report for the Ontario Stroke System. Canadian Stroke Network, August 2006.
52. Goldstein LB. Advertising strategies to increase the public knowledge of the warning signs of stroke [editorial]. *Stroke* 2003;34:1968–1969.
53. Ipsos Reid Ontario Omnibus. Available at: www.ipsos.ca/pdf/ipsos_ontarioOmni.pdf.
54. Heart and Stroke Foundation. Stroke Warning Signs. Available at: <http://ww2.heartandstroke.ca/Page.asp?PageID=33&ArticleID=709&Src=stroke&From=SubCategory>
55. Howard VJ, McClure LA, Meschia JF, Pull L, Orr SC, Friday GH. High prevalence of stroke symptoms among persons without a diagnosis of stroke or transient ischemic attacks in a general population. The Reasons for Geographic And Racial Differences in Stroke (REGARDS) study. *Arch Intern Med*. 2006;166:1952–1958.
56. Noar SM. A 10-year retrospective of research in health mass media campaigns: where do we go from here. *J Health Commun*. 2006;11:21–42.
57. Grilli R, Freemantle N, Minozzi S, Domenighetti G, Finer D. Mass media interventions: effects on health services utilisation. *Cochrane Database Syst Rev*. 2000;(2):CD000389.

58. Pechmann C, Reibling ET. Anti-smoking advertising campaigns targeting youth: case studies from USA and Canada. *Tob Control*. 2000; 9(Suppl 2):I118–I131.
59. McVey D, Stapleton J. Can anti-smoking television advertising affect smoking behaviour? Controlled trial of the Health Education Authority for England's anti-smoking TV campaign. *Tob Control*. 2000;9:273–282.
60. Pribble JM, Goldstein KM, Majersik JJ, Barsan WG, Brown DL, Morgenstern LB. Stroke information reported on local television news: a national perspective. *Stroke*. 2006;37:1556–1557.
61. Lewis M, Trypuc J, Lindsay P, O'Callaghan C, Dishaw A, Kapral M. Has Ontario's stroke system really made a difference *Healthcare Q*. 2006;9: 50–59, 2.
62. Ricci S, Celani MG, Vitali R, La Rosa, Righetti E, Duca E. Diurnal and seasonal variations in the occurrence of stroke: a community-based study. *Neuroepidemiology*. 1992;11:59–64.
63. Jakovljevic D, Salomaa V, Sivenius J, Tamminen M, Sarti C, Salmi K, Kaarsalo E, Narva V, Immonen-Raiha P, Torppa J, Tuomilehto J. Seasonal variation in the occurrence of stroke in a Finnish adult population. The FINMONICO Stroke Register. Finnish Monitoring Trends and Determinants in Cardiovascular Disease. *Stroke*. 1996;27: 1774–1779.
64. Wang H, Sekine M, Chen X, Kagamimori S. A study of weekly and seasonal variation of stroke onset. *Int J Biometeorol*. 2002;47:13–20.
65. Anderson N, Feigin V, Bennett D, Broad J, Pledger M, Anderson C, Bonita R. Diurnal, weekly, and seasonal variations in stroke occurrence in a population-based study in Auckland, New Zealand. *NZ Med J*. 2004; 117:U1078.
66. Kelly-Hayes M, Wolf PA, Kase CS, Brand RN, McGuirk JM, D'Agostino RB. Temporal patterns of stroke onset. The Framingham Study. *Stroke*. 1995;26:1343–1347.
67. Field TS, Hill MD. Weather, Chinook, and stroke occurrence. *Stroke*. 2002;33:1751–1757.
68. Frost L, Vukelic Andersen L, Mortensen LS, Dethlefsen C. Seasonal variation in stroke and stroke-associated mortality in patients with a hospital diagnosis of nonvalvular atrial fibrillation or flutter. A population-based study in Denmark. *Neuroepidemiology*. 2006;26: 220–225.
69. Rothwell PM, Wroe SJ, Slattery J, Warlow CP. Is stroke incidence related to season or temperature The Oxfordshire Community Stroke Project. *Lancet*. 1996;347:934–936.
70. Khan FA, Engstrom G, Jerntorp I, Pessah-Rasmussen H, Janzon L. Seasonal patterns of incidence and case fatality of stroke in Malmo, Sweden: the STROMA study. *Neuroepidemiology* 205;24:26–31.