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Does stroke health promotion increase awareness of appropriate behavioural response? Impact of the face, arm, speech and time (FAST) campaign on population knowledge of stroke risk factors, warning signs and emergency response

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Abstract

Introduction: Inability to identify stroke warning signs accurately is an important cause of delay in seeking medical attention, leading to potential ineligibility for acute intervention. We report on post-campaign findings (wave 2) of national surveys to estimate changes in population knowledge following a media-based Face, Arm, Speech, Time stroke awareness campaign, comparing findings to those of a pre-campaign population survey (wave 1).

Participants and methods: One thousand and ten randomly selected adults (18+) completed the Stroke Awareness Questionnaire on knowledge of warning signs, risk factors and response to stroke at wave 2 and findings were compared to wave 1 survey results. Logistic regression was used to examine the association between demographic characteristics and self-reported risk factors with knowledge of stroke and emergency response.

Results: No significant differences existed in the ability of respondents to define stroke or to identify two or more stroke risk factors between waves 1 and 2 surveys (71% and 70%, respectively). Respondents to the wave 2 survey were five times more likely (odds ratio 4.9, $p < .001$) than those responding at wave 1 to know at least two warning signs of stroke (67% vs. 31%, respectively), specifically those targeted by the Face, Arm, Speech, Time campaign. While significant improvement in intention to call an ambulance was noted (odds ratio 1.5, $p < .001$, 57% at wave 2 compared to 47% at wave 1), for almost half of respondents (43%) this would not have been their first response to stroke. Less than 5% of respondents to both surveys identified thrombolysis as an emergency treatment for stroke (3.9% at wave 2 compared to 1.8% at wave 1).

Discussion: Although significant improvements were made in several areas of stroke knowledge and intended response, awareness of acute stroke interventions was poor and intended behavioural response was suboptimal.

Conclusion: Findings from this study indicate need for targeted campaigns to improve population understanding of the reasons underlying the importance of rapid emergency response to stroke.

Keywords

Stroke, stroke knowledge, stroke awareness, stroke warning signs, face, arm, speech, time

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Introduction

Recent advances in acute interventions for ischaemic stroke have proven highly effective in improving survival and functional outcomes.[1,2] The ability to recognise stroke and access emergency stroke care decreases mortality and reduces disability after stroke.[1-4] Patient delay in seeking medical attention is a significant barrier to accessing acute interventions such as thrombolysis and thrombectomy, with inability to identify stroke warning signs contributing to patient delays.[5-10] There is evidence that increasing population awareness of the warning signs and appropriate response to stroke reduces patient delay in seeking emergency medical care.[5,6,11,12]

In 2009, a national population survey of adults (18+) was conducted in the Republic of Ireland to establish baseline information on population knowledge of stroke risk factors and warning signs, and to identify factors contributing to delay in seeking medical attention following a suspected stroke.[10] Findings of this survey indicated poor knowledge of stroke warning signs and that less than half of respondents would phone an ambulance should signs or symptoms of stroke occur. Following this population awareness survey, a national media campaign was conducted (sponsored by the Irish Heart Foundation (IHF)). This campaign used the 'FAST' (Face, Arm, Speech, Time to telephone for ambulance) message and was broadcast on radio, television and other advertising media throughout 2010 and 2011. The FAST campaign is designed as a short, easy to remember mnemonic aimed at increasing population recognition of common warning signs for stroke (facial paralysis, loss of power in one arm, speech disturbance) and the appropriate behavioural response (phone emergency services immediately).[12] The brevity of the message is considered an advantage in population stroke education and the FAST campaign has been used extensively internationally.[12-15]

The FAST campaign was broadcast for the first time in Ireland between May 2010 and June 2011, described in detail by Mellon et al.[16] The campaign was broadcast through national radio and television, and regional radio, advertising funded by the IHF using a version of the advertisement purchased from the UK, adapted solely by using a voiceover with a local Irish accent. Three major waves of the media campaign were broadcast during this period with continuous television advertising during the day and in the evening for three-week periods in May 2010, August 2010 and January 2011. The study period incorporated the three intensive periods of television broadcasting of the advertisement, with post-campaign (wave 2) data collection commencing the day after the final television

broadcast, on 1 February 2011. Data collection was completed over a seven-day period. The campaign was high volume with an average 73.4 gross rating points (GRPs) for the study period. The GRP is a measurement of the size of the audience exposed to a particular media message expressed as a percentage, with higher GRP indicating greater population exposure. No other forms of advertising of the FAST message were used during this media campaign, to enable evaluation of the impact of the media message alone.

The aim of this second population survey was to establish if improvements in population knowledge of stroke warning signs and emergency response occurred following the intensive phase of the roll-out of the FAST media campaign in Ireland.

Methods

The methods used for this second survey were identical to those used in the initial survey,[10] as follows:

Sample

Respondents were interviewed in one wave of data collection, commencing the day after completion of the intensive phase of the campaign in 2011. The sample comprised 1010 randomly selected adults aged 18+. This sample size had an associated standard error of $\pm 3\%$ at a 95% confidence interval (CI). Participants were selected using quota sampling (weighted for age, gender, social class and geographical region) based on the most recent Irish Census at commencement of the survey (2006). Analysis of the data used weighting from the Irish census conducted in the year of the survey (2011). Minimal exclusion criteria were applied, namely being under the age of 18 years and not being able to speak English. Participants were excluded also once the quota to which they belonged had been filled.

Measure

The measure used was the Stroke Awareness Questionnaire (SAQ), described and reproduced in the publication of the first population survey.[10] The SAQ contains questions assessing awareness of the cause of stroke, stroke risk factors, stroke warning signs, appropriate behavioural response to stroke symptoms and understanding of acute interventions for stroke. While the target of the FAST campaign is assessed by the questions relating to awareness of stroke warning signs and the appropriate behavioural response, other areas of the questionnaire provide information on gaps in population awareness of stroke, enabling development of further initiatives for population education on stroke. These questions also

acted as 'control' questions, and facilitated evaluation of the sensitivity and specificity of the FAST message.

Procedure

Details of the phone interview methodology are provided in Hickey et al.[10] Using random digit dialling, members of the public were contacted by telephone and asked to take part in a survey being conducted by a market research company (Red C) on behalf of the IHF. The sample had the potential to represent 98% of the Irish population as random digit dialling selects landline, ex-directory and mobile telephone numbers to reduce exclusion of population subgroups, such as those without landlines. Quota sampling aimed to achieve a representative sample of the population and standard call-back procedures were employed.

All interviewers were experienced market researchers who had been trained in administering the SAQ.[10] Questions were asked in the same order of all participants, with no prompts and interviews were monitored for consistency for the duration of the survey. Random call-back procedures were in place to validate questionnaire responses and to answer any queries from the public.

Ethics approval

Approval for this survey was granted by the Research Ethics Committee of the Royal College of Surgeons in Ireland (REC456). Participants were asked initially if they or a loved one had experienced a stroke recently, in which case they were given the opportunity to end the interview. If participants became concerned that they were at risk of having a stroke, they were advised to contact either the IHF (telephone number provided) or their General Practitioner (GP).

Data analysis

Post-campaign (wave 2) data were combined with the pre-campaign (wave 1) data set to allow comparisons to be made. Logistic regression analysis was used to compare responses across waves. Data was analysed using Stata/SE Release Version 11 and weighted based on age, in order to account for the under-sampling of young males aged 18–24. A number of variables were recoded as dichotomous variables to enable logistic regression analyses to be conducted, specifically:

(i) knowledge – defined as being able to state correctly, unprompted, two or more risk factors or warning signs for stroke *versus* those who could not;

(ii) intended response to stroke – those who stated they would call an ambulance constituted the correct response group, remaining participants classified as 'other';

(iii) age was collapsed into two groups consisting of those aged 18–64 years and those aged ≥65 years.

Uncued descriptions of stroke were classified in a sequential process. Participants were assigned to the first category for which they qualified:

1. Understanding: a correct description of what constitutes stroke, e.g., a circulation problem in the brain, a blood clot in the brain.
2. Recognition: a symptomatic description that contained observable features of a stroke, such as weakness or paralysis on one side of the body, without knowing the cause.
3. Partial: Not meeting the criteria above, but giving a partially correct definition or description, e.g., blood clot in the arteries (location unspecified), difficulty walking.
4. Wrong: not meeting the criteria above, and incorrect, e.g., a heart attack, stress.
5. Don't know: could not provide any description of a stroke.

Data were compared to wave 1 survey data from 2009[10] to estimate changes in population knowledge of stroke after the FAST campaign. Logistic regression was used to identify demographic and self-reported risk factors independently associated with knowledge of warning signs, risk factors and response to stroke. Analyses were also carried out to identify whether knowing two or more risk factors or warning signs for stroke was associated with a person's intended response to stroke. Sociodemographic factors including gender, age and urban/rural location were adjusted for in these analyses. Sampling weights were applied in the analysis to adjust the sample demographic to match that of the population, using most recent census data (2011).[17]

Results

To achieve the target sample of 1000 participants, a total of 7074 phonecalls were made. Just under three-quarters of the numbers were valid (5079/7074, 71.8%): 73% (3700/5079) were excluded because they were either business numbers, were not answered after three separate attempts at different times or were answered by an answering machine; 3.4% (175/5079) were faxes or modems; 22.0% (1117/5079) were non-existent numbers and 0.6% (33/5079) had language barriers preventing participation in the interview.

Table 1. Classification of unprompted descriptions of stroke between waves.

Level of knowledge	Wave 1	Wave 2	Sig*
Reference category			
Don't know	11	11	
Understanding	32	29	RRR = 0.87, p = 0.393
Recognition	26	36	RRR = 1.33, p = 0.074
Partial	15	13	RRR 0.75, p = 0.123
Wrong	17	10	RRR 0.63, p = 0.014

RRR: relative risk ratio.
*Multinomial logistic regression.

Table 2. Knowledge of stroke risk factors by survey wave.

Risk factor	Wave 1	Wave 2	Sig*
Smoking	55	50	OR 0.84, p = 0.062
Overweight	41	33	OR 0.73, p = 0.001
Lack of exercise	32	30	OR 0.92, p = 0.412
High blood pressure	27	31	OR 1.2, p < 0.05
High cholesterol	20	23	OR 1.1, p = 0.199
Hereditary	16	13	OR 0.77, p = 0.052
Poor Diet	19	28	OR 1.6, p < 0.001
Increasing age	7	8	OR 1.2, p = 0.306
Unable to identify	8	10	OR 1.2, p = 0.221

OR: odds ratio.
*Logistic regression.

Of the eligible households reached ($n = 1995$), 28.9% (577/1995) declined to take part; 19.1% (382/1995) of calls resulted in 'soft refusals' (e.g. 'ring back tomorrow' on each of three attempted calls). One percent (21/1995) of interviews were stopped midway by either the interviewer or the participant. The response rate for the survey, therefore, was 50.6% (1010/1995).

Sample profile

The nationally representative sample of 1010 consisted of 479 men (48%) and 531 women (52%); more than half of the sample (61%) was married and a quarter (26%) was single. Reflecting the general population, the 25–34 age group contained most participants (24%).

Knowledge of stroke

Unprompted descriptions given by respondents of what constitutes a stroke are summarised in Table 1. Stroke descriptions were compared between survey waves using multinomial logistic regression, using the 'don't know' category (which had an 11% prevalence at both time points) as reference category. The comparison was weighted for sample demographics.

Compared with time 1, respondents at time 2 were significantly less likely to provide a wrong description rather than saying they didn't know (relative risk ratio (RRR) = 0.63, 95% $p = 0.014$). There were no significant changes in the relative proportions giving explanations that involved understanding what constitutes stroke (RRR = 0.87, $p = 0.393$); recognition of stroke symptoms (RRR = 1.33, $p = 0.074$) or a partial description (RRR 0.75, $p = 0.123$).

When asked to provide a definition for Transient Ischaemic Attack (TIA), the majority of participants (83.2%) stated they did not know. Only 11.4% could give a correct definition while 5.4% provided incorrect answers. There were no significant differences in the ability to define TIA between wave 1 and wave 2.

Knowledge of stroke risk factors

Knowledge of stroke risk factors was defined as being able to correctly identify correctly two or more risk factors, as classified by the National Institute of Neurological Disorders and Stroke (NINDS),[18] in response to an unprompted question. The mean number of risk factors correctly identified was 2.2, almost identical to the previous survey.[10] The majority of participants (70%) could correctly name two or more risk factors, similar to wave 1 (71%), with no significant difference between waves ($p = 0.968$, Poisson regression). The pattern of identification of stroke risk factors shifted between waves (Table 2), with more people in wave 2 citing poor diet (28% vs. 19% in wave 1, $p < 0.001$), and blood pressure (31% vs. 27%, $p < 0.05$) and fewer people citing overweight (33% vs. 41%, $p = 0.001$). Roughly similar proportions in both waves stated they were unable to identify any risk factors for stroke (14% in wave 2 compared to 12% in wave 1). In terms of respondents' personal risk factors for stroke, there was no significant difference in risk factor prevalence between survey waves.

Knowledge of stroke warning signs

Knowledge of the warning signs for stroke was assessed using an open-ended question with no prompts and knowledge was defined as being able to identify correctly two or more signs, as classified by NINDS.[18] Over two-thirds (67%) of respondents were able to correctly identify two or more warning signs, doubling wave 1 figures (31%). Wave 2 respondents were five times more likely (odds ratio [OR] 4.9, $p < 0.001$) to know at least two warning signs of stroke than wave 1 respondents. The proportion that did not know any warning signs of stroke likewise fell from 23% in wave 1 to 5% in wave 2 (OR 0.26, $p < 0.001$).

Table 3. Knowledge of stroke warning signs by survey wave.

Warning sign	Wave 1	Wave 2	Sig*
Facial weakness, fallen face	13	55	OR 8.3, $p < 0.001$
Slurred speech	21	52	OR 4.1, $p < 0.001$
Lack of use of limbs	1	5	OR 5.2, $p < 0.001$
Face, arm, speech, time (FAST)	14	32	OR 2.9, $p < 0.001$
Dizziness	17	5	OR 0.27, $p < 0.001$
Weakness on one side	15	22	OR 1.6, $p < 0.001$
Severe headache	14	8	OR 0.51, $p < 0.001$
Numbness on one side	13	15	OR 1.2, $p = 0.286$
Visual problems	8	5	OR 0.67, $p < 0.05$
Difficulty understanding	8	7	OR 0.92, $p = 0.658$
Loss of movement	1	2	OR 1.8, $p = 0.119$
Disorientation	<1	<1	OR 1.8, $p = 0.237$
Lack of coordination	<1	<1	OR 1.3, $p = 0.613$
Unable to identify	23%	4%	OR 0.15, $p < 0.001$

OR: odds ratio.
*Logistic regression.

The most frequently listed warning signs of stroke were facial weakness or fallen face (55% in wave 2 against 13% in wave 1), slurred speech (52% against 21%), face/arm/speech/time (FAST) (32% vs. 14%), weakness on one side of the body (22% vs. 15%) and numbness on one side (15% vs. 13%) (Table 3). Only a minority of participants stated that problems with vision (5% vs. 8%), severe headache (8% vs. 14%) and difficulty understanding/sudden confusion (7% vs 8%) were stroke warning signs. Incorrect warning signs were rarely identified in wave 2, but included chest pains (4%, down from 11% in wave 1) and shortness of breath (4% down from 8%).

Knowledge of stroke campaigns (FAST)

Respondents were asked if they had seen or heard any advertisements recently about what to do in the event of a stroke. Almost 9 out of 10 respondents (87%) had heard a radio or TV stroke advertisement, with 7 out of 10 (71%) reporting seeing a television advertisement. Of those who had seen or heard the stroke campaign, over one-third (38%) had seen and could describe the detail of the FAST advertisement and a further 15% recalled seeing an advertisement depicting a man/woman with fire burning on their forehead.

Response to stroke

When asked how they would respond if they thought that they were having a stroke or were witnessing someone having a stroke, respondents in wave 2 were significantly more likely (OR 1.5, $p < .001$) to state that they would call an ambulance (57.2% compared to

Table 4. First response to suspected stroke.

Response	Wave 1	Wave 2	Sig*
Call ambulance	47.1	57.2	OR 1.5, $p < 0.001$
Get other medical help	24.2	14.6	OR 0.53, $p < 0.001$
No effective action (e.g. wait)	22.4	23.4	OR 1.1, $p = 0.626$
Don't know	6.3	4.9	OR 0.77, $p = 0.218$

OR: odds ratio.
*Logistic regression.

47.1% in wave 1; Table 4). Almost three-quarters of the sample in wave 2 (72%) stated they would seek medical assistance, either by phoning an ambulance (57.2%), or by getting other medical help, such as contacting their GP (11.6%), or driving or being driven to the hospital (3%). Very few participants (2.2%) said they would do nothing or try to ignore it. However, 1 in 20 (4.9%) did not know what they would do.

Awareness of availability of emergency intervention for stroke

Knowledge of acute interventions for stroke was examined by asking respondents if they thought it was possible to reduce the extent and effects of stroke by using certain forms of treatment within a few hours of a stroke. The majority of participants (91%) were aware of emergency treatments for stroke. The remainder stated that it was not possible to reduce the extent or effects of stroke (3%) or they did not know if treatments existed (6%). Despite the majority being aware of treatments for acute stroke, almost three-quarters were unable to name any specific emergency interventions. Overall, while respondents in wave 2 were more likely to state that there were emergency treatments for stroke than wave 1 respondents (OR 1.5, $p < 0.01$), respondents in waves 1 and 2 were equally likely to state they could not name, or did not know of any specific emergency interventions. Respondents in wave 2 were twice as likely (OR 2.2, $p = 0.01$) to identify thrombolysis (unprompted) as a possible emergency treatment than in wave 1, although only a small percentage at each wave provided this response (3.9% at wave 2 compared to 1.8% at wave 1).

Factors associated with knowledge of risk factors for stroke

Investigation of the factors associated with correctly identifying two or more risk factors for stroke indicated that better knowledge of risk factors was significantly associated with gender and age. Men were 28% less likely to know two or more risk factors for stroke than

women (OR = 0.72, $p = 0.035$). Age showed an increase in knowledge up to age 65 (OR 1.2 for each decade increase in age, $p = 0.16$) but respondents over the age of 65 were 42% less likely to know of two or more stroke risk factors than respondents under 65 years (OR = 0.58, $p = 0.012$).

Participants who themselves had a risk factor were significantly more likely to identify it as a risk factor for stroke. Specifically, those with high blood pressure (OR 1.9, $p < 0.001$), high cholesterol (OR 1.8, $p < 0.001$) and smokers (OR 2.2, $p < 0.001$) were approximately twice as likely to identify it as a risk for stroke as those who did not themselves have the risk factor in question.

Factors associated with knowledge of warning signs for stroke

When factors associated with the ability to identify two or more warning signs for stroke were investigated, in contrast to wave 1 findings, no differences were found based on respondents' age (over/under 65) and marital status. There was no difference also based on rural/urban domicile. However, similar to wave 1 findings, men were less likely than women to correctly identify two or more warning signs for stroke (OR = 0.70, $p < 0.05$). Respondents who themselves had a personal risk factor for stroke (e.g. high blood pressure or high cholesterol) were no more likely than those without a personal risk factor to be able to identify correctly two or more warning signs for stroke. Likewise, those who had a history of previous stroke, myocardial infarction (MI) or angina were no more likely to be able to identify two or more warning signs.

Factors associated with intended response to stroke

Participants under 65 years were more than twice as likely to state that they would call an ambulance in the case of stroke (OR 0.43, $p < 0.001$). Investigation of the association between rural/urban domicile, marital status and sex on a person's intended response indicated no significant relationships. Participants that could correctly list two or more warning signs of stroke were significantly more likely than those with poorer knowledge to state that they would call an ambulance if having or witnessing a stroke (OR 1.6, $p = 0.001$). Similarly, if a respondent knew of two or more risk factors they were more likely to call an ambulance (OR 1.4, $p = 0.022$). Respondents who recalled advertising about stroke on TV or radio were also more likely to call an ambulance (OR 1.4, $p = 0.015$). Again, participants with existing vascular disease (MI, stroke, angina) were no more likely to call an ambulance than those without.

Discussion

This study is a follow-up to the first national survey in Ireland of general population awareness of stroke and followed the introduction of the FAST campaign. The results show an important increase in the ability of the public to correctly recognise stroke warning signs, particularly those that are the focus of the FAST campaign, and a corresponding decrease in those who had partial or incorrect ideas about stroke, such as chest pain or palpitations. The campaign had success also in cueing recognition to action, with a significant association between both ability to name stroke warning signs and recall of media advertising, and intention to call an ambulance.

Knowledge of risk factors for stroke was high, and rates did not differ between survey waves.[10] Risk factor knowledge in this survey was higher than that reported in other studies,[19–22] with almost three-quarters of the sample correctly listing two or more risk factors. The most frequently listed risk factors were smoking, overweight and lack of exercise. It is likely that many participants simply identified generic risk factors for health conditions, reflecting media focus on obesity and smoking relating to Irish health policy.[23,24] When risk factors specifically related to increased risk for stroke were examined, levels of public knowledge were much lower. For example, although population prevalence of blood pressure is relatively high,[25] respondents had low levels of awareness of blood pressure as a risk factor for stroke.

Knowledge of stroke warning signs and appropriate response increased significantly pre- to post-implementation of the FAST campaign. The ability to name two or more stroke warning signs almost doubled, a significant improvement from wave 1 and a somewhat greater improvement than has been reported in other studies.[19,21] The most frequently reported warning signs were those of the campaign, namely, facial weakness, slurred speech, FAST symptoms and weakness on one side of the body. Of the warning signs targeted in the FAST advertisement, wave 2 respondents were eight times more likely to identify facial weakness, five times more likely to identify lack of use of limbs, four times more likely to identify slurred speech and approximately three times as likely to identify the FAST set of warning signs than in wave 1. Retention of the message in relation to facial changes, in particular, has been reported previously.[26] There were, however, a number of respondents also identifying incorrect warning signs such as shortness of breath and chest pain, indicating ongoing confusion between the warning signs for stroke and those for heart attack.

Knowledge of warning signs for stroke has consistently been shown to be influenced by factors such as

gender, socioeconomic status and age.[13,22] Such demographic differences were evident in the wave 1 survey (age, gender and marital status)[10] but age and marital status were no longer significant in distinguishing knowledge levels at wave 2. Gender continued to be significant in wave 2, women continuing to have higher levels of knowledge of stroke warning signs than men. Importantly, increasing age – itself a risk factor for stroke – is associated with significantly lower knowledge of stroke warning signs and intention to call emergency services in those aged over 65.

In terms of immediate response to stroke, following exposure to the FAST campaign respondents were significantly more likely to intend to phone for an ambulance if symptoms occurred. However, while a statistically significant increase, only just over half of respondents indicated they would call emergency medical services, a substantial number indicating they would seek medical help using non-emergency means, including contacting a GP and, in a small number of cases, driving or being driven to hospital. Thus while an increase of 10% on wave 1 findings, there is a relative lack of impact of the FAST campaign on appropriate behavioural intentions, which are likely to be further eroded by the well-documented 'intention-behaviour gap'.[27] Poor translation of the FAST message into appropriate behavioural response has been reported previously.[5,6,16,22] For example, the behavioural response to the FAST campaign was examined using an interrupted time-series design for the 12 months after the media FAST campaign completed in Ireland in June 2011.[16] Findings indicated a significant increase in attendance of patients reporting stroke symptoms after the first intensive wave of television advertising, which was not sustained for subsequent waves. Poor maintenance of increased knowledge following media campaigns has been reported elsewhere in the context of stroke[28] and in the context of media campaigns targeting other areas of health awareness and behaviour change.[29] In this study, the poor translation of increased awareness of stroke warning signs to appropriate behavioural response may be explained by a lack of understanding of the time-limited nature of acute interventions for stroke. Respondents in this study were asked about their knowledge of acute stroke interventions and, while there was an understanding that there are emergency interventions available for stroke, the vast majority of respondents were unable to name any acute intervention and had no awareness of the time-limited nature of such acute interventions.

The FAST advertisement campaign is widely used internationally to promote population awareness of stroke warning signs and appropriate response.[13,15,30] This study provides evidence that the FAST campaign impacts significantly on awareness of stroke warning signs and, to a lesser extent, on the appropriate emergency response. The message has high specificity, evidenced by the lack of impact of the campaign on population awareness of aspects of stroke not addressed by the FAST message, such as stroke risk factors, including important risk factors such as TIA or hypertension, or of possible emergency interventions for treating acute stroke. There are ways in which further improvements to the FAST message can and should be made. In particular, the public do not appear to assimilate the 'T' component of the message. Findings from this survey indicate that this may be because the message does not create specific awareness about the time-limited nature of acute stroke interventions.

In conclusion, this evaluation of the FAST campaign in Ireland highlights the important impact of media-driven health promotion campaigns on population knowledge and awareness of stroke. Further campaigns are needed to maintain levels of public understanding of stroke signs and appropriate response. In particular, there is a need to focus on highlighting the reasons for the importance of the emergency response to stroke, creating an understanding of the time-limited availability of acute stroke interventions.

Ethical approval

Ethical approval for this study was granted by the Research Ethics Committee of the Royal College of Surgeons in Ireland (approval number: REC456).

Guarantor

AH.

Contributorship

AH conceived and sought funding for the study and liaised with the funding agency and market research company. AH and ES were involved in the development of the original Stroke Awareness Questionnaire and in its amendment for this post-campaign survey. AH and LM were involved in obtaining ethical approval for the study, researched literature and wrote initial drafts of the paper. RC analysed the study in consultation with AH. All authors were involved in monitoring progress of the study and in reviewing and editing the manuscript, and approved the final version of the manuscript.

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