REVIEW

Stroke knowledge and awareness: an integrative review of the evidence

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Abstract

Background: the recognition of stroke symptoms by the public and activation of the emergency medical services (EMS) are the most important factors in instigating pre-hospital stroke care. Studies have suggested that poor recognition of the warning signs of stroke is the main cause of delay in accessing the EMS.
Methods: an integrative review of published studies about stroke knowledge and awareness was performed by searching online bibliographic databases, using keywords, from 1966 to 2008. Studies were included in the review if they focussed on risk factors, signs and symptoms, action and information. Each study was reviewed by two researchers (SJ and MJ).
Results: we identified 169 studies of which 39 were included in the review. The ability to name one risk factor for stroke varied between studies, ranging from 18% to 94% when asked open-ended questions and from 42% to 97% when asked closed questions. The ability to name one symptom ranged from 25% to 72% when asked open-ended questions and from 95% to 100% when asked closed questions. When asked what action people would take if they thought they were having a stroke, between 53% and 98% replied that they would call the EMS. People generally obtained information about stroke from family and friends. Older members of the population, ethnic minority groups and those with lower levels of education had consistently poor levels of stroke knowledge.
Conclusions: generally, levels of knowledge about recognising and preventing stroke were poor. Nevertheless, most participants stated they would contact the EMS at the onset of stroke symptoms.

Keywords: *cerebrovascular accident, awareness, symptom, risk factor, elderly*

Background

Stroke is the third most common cause of mortality in the developed world and is also the leading cause of adult neurological disability. Due to ageing populations worldwide, it has been estimated that by 2020 stroke will be the leading cause of lost healthy life-years.

To combat the effects of stroke, the time from the onset of stroke symptoms to hospital arrival must be improved in order to provide timely and effective treatment. Many factors contribute to delays in seeking treatment for stroke, but the principal factor is believed to be a lack of public knowledge regarding stroke symptoms and the need for a rapid response [1, 2]. Studies have suggested that activation of emergency medical services (EMS) is one of the most important factors in instigating pre-hospital care [1] and that poor recognition of the symptoms of stroke may be partially responsible for delays in accessing the EMS [3, 4]. Achieving rapid patient presenta-

tion relies mainly on the public's ability to identify the symptoms and to contact the EMS without delay [5].

The purpose of this study was to systematically review and summarise the existing scientific literature exploring the knowledge of the public, stroke patients and carers in relation to the risk factors, symptoms, treatments and sources of information around stroke and transient ischaemic attack (TIA).

Methods

Search strategy

A search strategy (Appendix 3) was developed to search Medline from 1966 to 2008, and adapted to search EMBASE, CINAHL, AMED, Cochrane and ZETOC. Two researchers (SJ and MJ) independently reviewed the titles and abstracts of the articles identified by this search. Additional articles were

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found by screening journals, citation tracking and hand searching. Any articles that appeared to meet the inclusion criteria were read in full.

Inclusion criteria

Participants could be the general public, stroke patients and people at risk of stroke. The assessment questions used to test knowledge could be open-ended, closed or multiple choice. The method of administration of the questions could be through telephone, face-to-face or postal survey. We excluded studies that were only published as abstracts because of the limited data that could be extracted. The studies included in the review were categorised under one or more of the following topics: knowledge of risk factors for stroke, knowledge of stroke symptoms, action taken if stroke is suspected and sources of stroke information. We have used the descriptor stroke to mean stroke or TIA.

Data extraction

We constructed two proformas. One proforma was used to record summary data for each article, including: period of study, participants, country, topic, and methodology of data capture; the second proforma recorded participants' knowledge on each topic.

Results

From the electronic search, we identified 169 articles. Following screening of the title, abstract or complete article, 39 studies met the inclusion criteria. Of the studies, 30 tested participants' knowledge once. Nine studies tested knowledge before and after interventions that aimed to provide information about stroke. Five tested knowledge immediately after training; a further two also tested knowledge at 3 months. One study tested knowledge at a range of time points between 1 and 28 days post-intervention, and one tested knowledge at six separate time points over 3 years.

Location of studies and types of participants

The 39 studies of public awareness of stroke/TIA are summarised in Table 1 (further details for each study are available in the table Appendix 2 in the supplementary data on the journal website http://www.ageing.oxfordjournals. org/). The published studies come from the following locations: UK ($n=4$), Europe ($n=8$), North America ($n=20$), Asia ($n=6$) and Australia ($n=1$). In 28 studies, the participants were members of the general public; in four studies, the participants were stroke patients; and in three studies, knowledge was assessed in people at risk of stroke. One study assessed knowledge in relatives of non-stroke patients attending outpatient clinics. The remaining three studies involved a mixture of patients, the public, relatives and people at risk of stroke.

Risk factors

The ability to name one or more risk factors for stroke differed markedly between studies and ranged between 18% [6] and 94% when open-ended questions were asked and from 42% to 97% [7] when closed questions were asked (Table 2). The ability to identify individual risk factors appeared to be strongly related to how the questions were asked. When asked open-ended questions about the main risk factor for stroke, only 36% identified high blood pressure. Other risk factors commonly identified without the prompt of a question included stress, diet, alcohol excess, inactivity, older age and smoking as causes of stroke. In contrast, when given options, >80% recognised high blood pressure, previous stroke and a family history of stroke as risk factors.

Regardless of how questions were asked, there was an association between the number of risk factors identified and the age of the participant. Approximately 50% of patients <65 years were aware of their own personal risk factors for stroke, compared with 30% of those aged ≥65 years [8]. In two separate studies, 72% [9] and 57% of people <75 years could name at least one stroke risk factor compared with 56% [9] and 19% of people aged ≥75 years. A third study also found that older age was significantly associated with the inability to name at least one risk factor [10].

Inadequate risk factor knowledge was also more common among African Americans [6, 11] and people with lower levels of education [2, 6, 11, 12].

Signs and symptoms

The ability to name one symptom of stroke varied significantly between studies and ranged from 25% to 100%. The most commonly identified symptoms of stroke were numbness, weakness or paralysis, which ranged from 2% [13] to 97%; confusion, difficulty speaking or understanding speech, which ranged from 1% [13] to 100%; and dizziness, which ranged from 9% to 96%.

Similar to risk factor identification, recognition of stroke symptoms was poor when open-ended questions were used (Table 3). In one study, only 38% of participants could identify one or more symptoms when asked open-ended questions, compared with 100% when shown a list of possible symptoms. The ability of the public to name one symptom of stroke ranged from 25% to 72% when asked open-ended questions and from 95% to 100% [14] when asked closed questions.

As with risk factors, the respondent's age appeared to be associated with knowledge about stroke symptoms [2]. More participants aged 45–64 years (40%) were able to name at least two symptoms, compared with those aged ≥65 years (32%) [15]. Similarly, more patients <65 years (47%) knew a sign or symptom of stroke than those ≥65 years (28%), while symptom knowledge in those <70 years compared with those ≥70y was 86% and 69%, respectively. In a further study, at least one warning sign could be named by 60%

Table 1. Summary of included studies

Author	Participants	Sampling	N	Response rate	Who did interviews	Questions[a]	Topic[b]	Method[c]	Notes[d]
Alkadry [7]	Public	Random	1,172	56%	Self completion	MC	RF; SaS; A	Post	
Al Shafaee	People at risk	Random sample of people attending cardiology, neurology, diabetic and lipid clinics at a hospital	400	72%	Trained family practice	O	RF; SaS; A; I	F2F	
Becker	Public	Random	547	87%	ns	O	RF; SaS; A	Tel	Pre
		Random	511	84%	ns				Post
Carroll	Public		40	ns	Members of the neurology department	O	RF; SaS; A; I	F2F	
	Patients	Visiting patients and relatives on non-medical wards	40	ns	Members of the neurology department				
	People at risk	Admitted to hospital with stroke	40	ns	Members of the neurology department				
		Consecutive patients attending outpatient appointments							
Cheung [17]	Public	Random	1,222	62%	Trained interviewers	O; C	RF; SaS; A; I	Tel	
Croquelois	Patients	Consecutive patients attending stroke outpatients clinic	164	43%	ns	O	RF	F2F	
Das [30]	Public	Consecutive members of the public who visited hospital	4,660	ns	ns	O	RF; SaS; I	F2F	
	Patients	Stroke patients		ns					
DeLemos	Public	Convenience sample of public attending a community stroke screening programme	186	47%	Health professionals	MC	SaS; A	F2F	Pre
		Convenience sample of public attending a community stroke screening programme	110	28%	Health professionals			F2F	Post
		Convenience sample of public attending a community stroke screening programme	78	20%	Health professionals			Tel	3months
Ferris [16]	Public	Random	1,024	95%	Professional interviewers	O; C	RF; SaS	Tel	
Greenlund [27]	Patients at increased risk	Random	61,019	53%	ns	O; C	SaS; A	Tel	
Gupta	Public	Consecutive patients attending a hospital clinic	410	ns	Trained interviewer	O; C	RF; SaS	F2F	
Handschu	Public	Consecutive participants attending first aid training courses	532	87%	St. Johns' Ambulance first aid instructors	O	SaS	ns	1–28days post
Hodgson [19]	Public	Random	6,693	ns	ns	O	SaS	Tel	At six time points
Hux	Public	Convenience sample of shoppers	190	ns	Trained interviewer	O; C	RF; SaS; A; I	F2F	
Johnston [28]	Public	Random	10,112	89%	ns	O	SaS	Tel	
Jurkowski [18]	Public	Random	1,789	17%	Professional survey research employees	C	SaS; A	Tel	
Kim [13]	Public	Random	1,000	ns	ns	O	RF; SaS; A; I	Tel	
Kothari	Patients	Patients admitted to ED with suspected stroke	163	94%	Stroke research nurse	O	RF; SaS	F2F	
Marx	Public	Random	507	ns	ns	O; C	RF; SaS; A; I	Tel	Pre
		Random	501	ns	ns	O; C	RF; SaS; A	Tel	Post
Mikulik	Public	Random	592	ns	Professional interviewer	O; C	RF; SaS; A; I	Tel	

Table 1. (*Continued*)

Author	Participants	Sampling	N	Response rate	Who did interviews	Questions[a]	Topic[b]	Method[c]	Notes[d]
Morgan	Public	Random sample from a GP practice	139	57%	Self completion	O; C	RF; SaS; A; I	Post	
Mosca	Public	Random	133	15%	Professional interviewer	O; MC	RF; SaS	Tel	
Müller-Nordhorn [12]	Public	Random	28,090	37%	Self completion	O; MC	RF; I	Post	
Nedeltchev	Public	Random people on the street in a city	422	ns	Medical students	O; C	RF; SaS; A; I	F2F	
Pancioli [9]	Public	Random	1,880	71%	Professional interviewer	O	RF; SaS; A; I	Tel	
Pandian	Relatives of outpatients (not stroke)	Random	942	75%	ns	O	RF; SaS; A; I	F2F	
Pandian	Patients; relatives	Consecutive stroke patients admitted to ED and their relatives	147	85%	Trained nurses and medical interns	O	RF; SaS	ns	
Parahoo	Public	Random	869	46%	Self completion	O; C	RF; SaS; A; I	Post	
Reeves [6]	Public	Random	2,512	45%	ns	O	RF; SaS; A	Tel	
Rowe [13]	Public	Random	602	48%	ns	O; C; MC	RF; SaS; A; I	Tel	
Samsa [8]	Patients at increased risk	Identified as being at risk from inpatient records	1,261	43%	Trained interviewer	O	RF; I	Tel	
Schneider [23]	Public	Random	1,880	ns	Professional interviewer	O	RF; SaS	Tel	Pre
			2,173	69%	Professional interviewer	O	RF; SaS; A; I	Tel	Post
Segura [10]	Public	Random	3,000	18%	Professional interviewer	O; C	RF; SaS; A	Tel	
Silver [15]	Public	Random	1,514	ns	Professional interviewer	O	SaS	Tel	Pre
			1,619	ns	Professional interviewer				Post
Stern [11]	Public	Volunteers in independent settings	657	100%	Health professional	MC	RF; SaS	F2F	Pre
		Volunteers in independent settings	657	100%	Health professional				Post
Wall	Public	Convenience sample from the MDPH Women's Health Network	34	100%	Self completion	MC	SaS; A		Pre
		Convenience sample from the MDPH Women's Health Network	72	100%	Self completion				Post
		Convenience sample from the MDPH Women's Health Network	65	86%	Self completion				3months
Weltermann	Patient stroke groups	Random selection of stroke support groups	133	96%	Self completion	O; C	RF; SaS; A	F2F	
Williams [22]	Patients	Consecutive stroke patients admitted to three hospitals	67	ns	Investigator	O	SaS	F2F	
Yoon [2]	Public	Random	1,278	62%	Trained telephone interviewer	O; C	RF; SaS; A; I	Tel	

ns, not stated. ED, Emergency Department.

a O, open-ended questions; C, closed questions; MC, multiple choice questions.
b RF, risk factors; SaS, signs and symptoms; A, action; I, information.
c Post, postal; F2F, face-to-face; Tel, telephone.
d Pre, pre-intervention; Post, post-intervention.

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Table 2. Knowledge of risk factors for stroke

Author	HT[a]	Smoking	Age	Cholesterol	IHD[b]	DM[c]	AF[d]	Alcohol excess	Previous stroke/TIA	Stress	Diet	Inactivity	Family history	Obesity	Notes
Al Shafaee	35%	5%	2%	9%	11%	23%	0%	4%	1%	0%	0%	3%	0%	6%	
Carroll	20%	23%	0%	10%	0%	5%	8%	5%	0%	18%	18%	3%	5%	5%	Public
	33%	40%	3%	13%	10%	3%	0%	20%	0%	20%	30%	5%	10%	23%	Patients
	28%	50%	0%	8%	15%	0%	0%	10%	0%	35%	28%	13%	8%	33%	At risk
Cheung [17]	90%	68%	53%	75%	58%	60%	42%	84%	83%	na	na	na	50%	75%	
Croquelois	47%	75%	0%	41%	0%	48%	0%	0%	0%	0%	0%	0%	0%	0%	
Das [30]	24%	24%	0%	11%	6%	25%	0%	24%	11%	0%	0%	0%	0%	0%	Public
	24%	24%	0%	15%	6%	19%	0%	21%	8%	0%	0%	0%	0%	0%	Patients
Ferris [16]	na	na	na	na	89%	na	na	na	na	na	na	na	na	na	
Gupta	48%	40%	0%	30%	11%	25%	0%	32%	5%	52%	42%	0%	0%	15%	O
	50%	40%	Na	29%	20%	48%	na	49%	29%	62%	33%	na	na	32%	C
Hux	48%	32%	0%	30%	8%	0%	0%	8%	0%	10%	21%	10%	13%	20%	O
	98%	95%	Na	93%	na	75%	na	80%	na	na	na	na	na	na	C
Kim [13]	29%	0%	4%	7%	0%	0%	0%	1%	0%	7%	0%	0%	1%	7%	
Kothari	44%	18%	0%	27%	3%	4%	0%	13%	0%	36%	4%	0%	0%	5%	
Marx	95%	95%	59%	0%	74%	67%	0%	0%	0%	0%	0%	0%	0%	93%	Pre[e]
Mikulik	29%	43%	0%	0%	2%	5%	0%	0%	4%	31%	0%	0%	0%	33%	
Morgan	94%	75%	na	na	na	na	na	67%	na	na	86%	76%	na	67%	
Müller-Nordhorn [12]	43%	39%	1%	13%	2%	8%	0%	16%	0%	18%	14%	20%	3%	34%	
Pancioli [9]	49%	19%	0%	16%	5%	3%	0%	4%	0%	23%	20%	0%	0%	16%	
Pandian	45%	1%	0%	7%	2%	11%	0%	0%	0%	41%	0%	2%	4%	3%	
Pandian	54%	6%	9%	3%	5%	31%	0%	0%	0%	12%	0%	0%	0%	1%	
Parahoo	36%	24%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Samsa [8]	94%	84%	63%	76%	51%	31%	na	61%	94%	67%	na	60%	84%	66%	
Schneider [23]	51%	22%	0%	21%	5%	5%	0%	5%	0%	21%	11%	11%	8%	18%	
Segura [10]	92%	88%	68%	84%	84%	59%	na	90%	na	68%	na	77%	na	87%	
Reeves [6]	32%	29%	4%	18%	5%	2%	0%	6%	0%	27%	25%	26%	9%	18%	
Rowe [14]	96%	89%	na	90%	86%	69%	na	83%	97%	na	na	89%	na	93%	
Weltermann	82%	50%	0%	36%	9%	25%	0%	19%	0%	0%	0%	0%	0%	0%	
Yoon [2]	32%	39%	0%	14%	0%	0%	0%	21%	0%	34%	32%	22%	22%	27%	
Stern [11]	Data extraction on individual risk factors not possible														
Alkadry [7]	97% knew one factor that increased risk														
Becker	60% knew one factor that increased risk; 65% knew one factor that increased risk														Pre; Post
Mosca	Data extraction on individual risk factors not possible														
Nedeltchev	Data extraction on individual risk factors not possible														

na, not applicable, where closed questions meant this was not an option.

[a]HT, hypertension.

[b]IHD, ischaemic heart disease.

[c]DM, diabetes mellitus.

[d]AF, atrial fibrillation.

[e]only pre-educational data were available for the individual risk factors.

of participants under <75 years compared with 47% aged ≥75 years [9]. Inadequate symptom knowledge was also more common among African Americans [6, 11, 16] and the Hispanic community [16].

Action

When participants were asked what action they would take if they suspected the symptoms of stroke, between 27% and 100% stated that they would call the EMS [2, 6, 17] (Table 4). In one study involving participants who had actually had a stroke, only 18% had called EMS; the majority (80%) responded by calling their general practitioner. When asked how they would respond to each symptom without reference to stroke, more participants (42%) were likely to take action if they experienced weakness/paralysis compared with an ex-perience of dizziness (3%) [2]. Older age was also shown to be associated with decreased likelihood to call 911 [18].

Sources of information

In the 16 studies that asked participants to identify the main ways in which they had gained information about stroke, a variety of sources were cited. For any given source of information, there was often a big difference between studies in terms of the number of participants who had gained information from that source. A relative or friend was often cited as a source of information, but this ranged from 0% to 60% [9]. Health professionals were also a source of stroke information for many people ranging from 0% [13] to 51%. Personal experience was a source of information cited in five studies, with between 20% and 58% of participants

Table 3. Knowledge of signs and symptoms for stroke

Author	Sided numbness	Weakness	Paralysis	Speech disturbance	Confusion	Loss of coordination	Dizziness	Loss of vision	Consciousness	Headache	Vomiting	Motor	Notes[a]
Alkadry [7]	92%	0%	0%	88%	0%	0%	0%	61%	0%	61%	0%	0%	
Al Shafaee	7%	65%	65%	30%	0%	0%	6%	3%	0%	3%	0%	26%	
Cheung [17]	na	62%	na	65%	na	57%	na	na	58%	na	na	na	
Das [30]	22%	22%	0%	21%	21%	15%	15%	11%	0%	10%	0%	0%	Public
	25%	25%	0%	22%	22%	20%	20%	10%	0%	8%	0%	0%	Patients
Ferris [16]	37%	0%	na	26%	0%	0%	20%	19%	0%	28%	0%	0%	
Greenlund [27]	94%	94%	na	88%	88%	86%	86%	68%	na	61%	na	na	
Hodgson [19]	0%	0%	49%	23%	0%	0%	43%	24%	0%	29%	0%	0%	Pre
	0%	0%	47%	31%	0%	0%	55%	34%	0%	32%	0%	0%	During
	0%	0%	46%	37%	0%	0%	59%	34%	0%	34%	0%	0%	Post
	0%	0%	44%	39%	0%	0%	63%	44%	0%	36%	0%	0%	During 2
	0%	0%	48%	41%	0%	0%	63%	45%	0%	32%	0%	0%	Post 2
	0%	0%	44%	34%	0%	0%	56%	37%	0%	31%	0%	0%	Post 3
Hux	33%	0%	0%	11%	na	0%	22%	12%	7%	16%	0%	11%	O[a]
	90%	90%	na	95%	na	Na	96%	89%	na	81%	na	na	C[b]
Johnston [13]	12%	12%	0%	5%	0%	13%	13%	9%	0%	0%	0%	0%	
Kim [13]	2%	0%	60%	2%	1%	5%	0%	1%	4%	0%	0%	0%	
Kothari	28%	34%	0%	28%	5%	35%	15%	0%	0%	11%	0%	0%	
Marx	0%	43%	43%	25%	0%	6%	0%	7%	0%	0%	0%	0%	O
Mikulik	0%	34%	0%	37%	0%	0%	0%	22%	20%	0%	0%	0%	
Morgan	81%	81%	na	73%	na	35%	22%	na	24%	27%	4%	na	
Mosca	36%	36%	0%	10%	0%	0%	10%	10%	0%	10%	0%	0%	
Pancioli [9]	11%	15%	0%	8%	0%	0%	24%	7%	0%	16%	0%	0%	
Pandian	0%	0%	62%	5%	0%	6%	0%	2%	6%	8%	0%	0%	
Pandian	5%	0%	62%	22%	0%	0%	5%	1%	0%	5%	0%	0%	
Parahoo	na	92%	na	90%	na	48%	na	42%	31%	25%	na	na	
Reeves [6]	46%	46%	0%	30%	30%	24%	24%	14%	0%	15%	0%	0%	
Rowe [14]	24%	24%	0%	14%	0%	10%	10%	5%	0%	8%	0%	0%	O
	95%	95%	na	93%	na	90%	90%	77%	na	77%	na	na	C
Schneider [23]	36%	20%	0%	16%	0%	0%	26%	13%	0%	19%	0%	0%	

Table 3. (*Continued*)

Author	Sided numbness	Weakness	Paralysis	Speech disturbance	Confusion	Loss of coordination	Dizziness	Loss of vision	Consciousness	Headache	Vomiting	Motor	Notes[a]
Segura [10]	69%	88%	na	80%	na	na	75%	70%	80%	79%	na	na	
Weltermann	21%	0%	0%	57%	0%	0%	0%	31%	11%	0%	0%	65%	
Yoon [2]	16%	4%	9%	14%	0%	0%	21%	24%	0%	22%	0%	0%	
Gupta	82% of patients gave correct responses, the commonest symptom reported was weakness												
Stern [11]	Groups who received both pre-test and post-test education had a significant increase in knowledge, mean 11%												
Williams [22]	Patients with previous stroke (76%) were as likely as those without stroke (88%) to think their symptoms were not serious												
Nedeltchev	Data extraction on individual symptoms not possible												
Carroll	Median symptoms identified: 2												Public
	Median symptoms identified: 2												People at risk
Becker	Number knowing >1 symptom: 39%												Pre
	Number knowing >1 symptom: 46%												Post
DeLemos	59% recognised three warning symptoms: numbness on one side, difficulty talking or understanding, difficulty with vision												Pre
	94% recognised three warning symptoms: numbness on one side, difficulty talking or understanding, difficulty with vision												Post
	77% recognised three warning symptoms: numbness on one side, difficulty talking or understanding, difficulty with vision												3months
Handschu	Mean number of stroke symptoms named: 1.5												Pre
	Mean number of stroke symptoms named: 3.3												Post
Silver [15]	Mean symptoms: 1.25; name two or more: 42%												Pre: print
	Mean symptoms: 1.28; name two or more: 39%												Pre: LLTV
	Mean symptoms: 1.32; name two or more: 40%												Pre: HLTV
	Mean symptoms: 1.38; name two or more: 44%												Pre: cont
	Mean symptoms: 1.17; name two or more: 41%												Post: print
	Mean symptoms: 1.47; name two or more: 50%												Post: LLTV
	Mean symptoms: 1.66; name two or more: 54%												Post: HLTV
	Mean symptoms: 1.10; name two or more: 36%												Post: cont

na, not applicable, where closed questions meant this was not an option.
[a]O, open questions; C, closed questions; LLTV, low level television campaign; HLTV, high-level television campaign.

Table 4. Action that should be taken if a stroke is suspected

Author	911	Call GP/Dr	Go to Dr	Call Hospital	Direct to hospital	Call for help	Seek medical attention	Family & friends & neighbours	Buy medicine from a shop	Do nothing	Don't know	Notes
Alkadry [7]	94%	na	na	na	94%	na	na	na	na	na	na	
Al Shafaee	na	na	na	na	73%	na	na	na	na	na	na	
Becker	68%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	Pre
	64%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	Post
Carroll	80%	20%	0%	0%	5%	0%	0%	0%	0%	0%	0%	Public
	18%	80%	0%	0%	0%	0%	0%	0%	0%	0%	0%	Patients
	73%	28%	0%	0%	0%	0%	0%	0%	0%	0%	0%	People at risk
Cheung [17]	49%	14%	0%	0%	29%	0%	0%	0%	0%	0%	0%	
DeLemos	47%	na	na	na	na	na	na	na	na	na	na	Pre
	98%	na	na	na	na	na	na	na	na	na	na	Post
Mikulik	27%	33%	na	na	na	na	na	na	na	10%		
Nedeltchev	64%	36%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Pandian	0%	15%	10%	0%	71%	0%	0%	0%	0%	0%	5%	
Parahoo	53%	42%	0%	0%	0%	0%	0%	2%	0%	0%	0%	
Reeves	79%	3%	0%	0%	4%	0%	0%	0%	0%	0%	4%	
Rowe [14]	70%	4%	26%	18%	9%	37%	9%	0%	0%	0%	5%	
Schneider [23]	74%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	
Segura [10]	45%	41%	13%	na	na	na	na	na	na	1%	na	
Weltermann	na	31%	na	na	64%	na	na	na	na	4%	2%	
Yoon [2]	67%	10%	9%	0%	23%	0%	0%	0%	0%	2%	2%	
Greenlund [27]				86% would call 911 if someone was having a heart attack or stroke								
Marx				Pre-intervention 81% would call EMS, post-intervention 82% would call EMS								
Morgan			96% thought it was extremely important; 3% thought it might be important and 1% thought it was not important to get immediate treatment									
Wall			99% would dial 999 following an educational intervention; this declined to 97% at 3 months post-intervention									

na, not applicable, where closed questions meant this was not an option.

gaining information about stroke through knowing a stroke survivor or their family.

A variety of media were identified as sources of stroke information. Television was cited as a source of information in all 16 studies, ranging from 1% to 82% [12], while radio was cited in nine studies. Literature, including books, magazines, pamphlets and newspapers, provided information for between 3% and 82% [12] of participants.

Gaining information through stroke campaigns was only identified in two studies by 3% and 27% of participants. Information gained from schools was identified in four studies by 2–16% [13] of participants. The Internet and public libraries were the least accessed sources of stroke information, cited in only three studies by 1–3% of participants.

Patients and those at risk

Ten (26%) papers included patients or those at higher risk of stroke. These studies still demonstrated that participants had a wide range of knowledge, with as many as 94% [8] and as few as 24% [30] of participants identifying hypertension as a major risk factor for stroke. The method of questioning was the same for both studies [8, 30]. Knowledge of the main symptoms of stroke was equally wide ranging, with between 0% and 65% recognising weakness and between 21% [30] and 57% identifying speech disturbance as stroke symptoms. These figures are within the ranges identified by members of the general public and suggest that having either experience of or being at risk of stroke does not appear to translate into an increase in stroke knowledge. One study did show that on-

ly 18% of patients sought help by calling an ambulance, but that there was a difference in the proportions calling an ambulance when stroke was recognised (25%) compared with when stroke was not recognised (13%).

As with the overall findings, the age of the patient or person at risk showed an association with knowledge. Approximately 50% of patients <65 years were aware of their own personal risk factors for stroke, compared with 30% of those ≥65 years [8]. Similarly, more patients <65 years (47%) knew a sign or symptom of stroke than those ≥65 years (28%). Symptom knowledge in those <70 years compared with those ≥70 years was 86% and 69%, respectively.

TIA

Only two studies looked specifically at knowledge related to TIA [28]. In one study, only 8% recognised TIA as symptoms of stroke resolving within 24 h and only 3% identified TIA as a disease that requires immediate medical help. In the other study, only 8% correctly identified the definition of TIA and only 9% could identify a typical symptom [28]. The term TIA was unfamiliar to 87% of participants. There were insufficient data to compare knowledge between people who have had a stroke and those with TIA.

Intervention studies

Nine studies used a pre- and post-test design. In the studies, the interventions were different types of public awareness campaigns. The impact of the interventions was assessed

in terms of the participants' knowledge rather than looking at actual health behaviour or other patient outcomes. In communities exposed to television and newspaper advertising, the numbers able to name the symptoms of stroke increased significantly from 24% to 27% [19] and from 39% to 46%. In a separate study, communities were exposed to either a television campaign or print advertising. There was no significant change in the community receiving newspaper advertising (42–40%), but in the community receiving television advertising, 54% of people were able to identify two or more symptoms compared with 40% at baseline [15]. Intermittent, low-level advertising was as effective as continuous, high-level advertising [15]. Prior to a stroke screening and education programme, 59% of participants were able to recognise weakness or numbness on one side, difficulty talking or understanding speech, and difficulty with vision, as symptoms of stroke. Immediately following the intervention, this increased to 94%, falling to 77% when knowledge was tested 3 months later. An animation to teach members of the public about the Face Arm Speech Test (FAST) found that, immediately after the intervention, 99% compared with 92% before the intervention were able to recognise facial droop as a symptom of stroke. Similarly, 97% were able to identify arm weakness or numbness after the intervention compared with 86% before the intervention. At 3 months after the intervention, 100% recalled slurred speech and 98.5% recalled arm weakness or numbness as a symptom of stroke; however, the number of participants who could remember all three components of the FAST had declined from 100% to 79%. A campaign that involved mass media, poster adverts, flyers and public events showed no significant change in knowledge about symptoms, risk factors or actions.

A professionally produced community slide/audio education programme was delivered to 657 adults [11]. Mean pre- and post-test scores increased from 69% to 79%. No benefit was seen if there was a facilitated discussion within the programme [11]. Following a first aid training course about stroke that was delivered over a whole day or in six 90-min sessions, the ability of participants to identify the symptoms of stroke increased from a mean of 1.5 symptoms to 3.4.

Discussion

To our knowledge, this is the first systematic review that has synthesised the published literature around knowledge of risk factors for stroke, knowledge of stroke symptoms, action taken if stroke is suspected and sources of stroke information. A previous review published in 2005 only addressed risk factor and symptom knowledge in a limited number of studies [20].

This review includes four studies from the UK. Hypertension and smoking were the main risk factors identified by participants across the studies. Knowledge of hypertension as a risk factor ranged from 20% to 94% and smoking from 23% to 75%; the range of these figures is more a reflection of the use of open and closed questions. One study found

that stroke patients' awareness was poor, with only 40% having identified that they were having a stroke. A family member was often the first person who was contacted by the patient and in 68% of cases it was the family member who then sought help from a health professional. Furthermore, the GP was the health professional contacted (80% of cases) rather than dialling 999 (18% of cases). When members of the general public were questioned, 42% said they would contact their GP if stroke was suspected while 53% stated they would contact the ambulance service. The data from the UK studies of stroke knowledge are similar to the data from other countries.

A lack of stroke knowledge among those who have already suffered a stroke is particularly worrying. There may be a number of possible explanations as to why this is the case. The content of information that was imparted may not be appropriate for some patients, in that it may be too complicated or too general [21]. Some patients may be unable to retain the information given to them for a variety of reasons [21].

Participants who had experienced a stroke initially did not take their symptoms seriously and had waited for their symptoms to abate [22]. Most did not know that they were experiencing stroke symptoms.

When asked what action they would take if they suspected that they or a relative were experiencing a stroke, at least 47% of participants stated that they would call the EMS or would visit a hospital emergency department. However, when stroke patients were asked about what they had actually done at the onset of symptoms, only 18% had actually called the emergency services.

This paradox between what people say they would do and what they actually do shows the limitation of simply asking questions. In the ideal world, questioning would simulate a 'real life' situation of having the stroke event because complex factors such as knowledge, emotions and fears are often considered in deciding what action should be taken. Questions that only assess knowledge do reveal that many people know what they should do. Our task is to determine how best to translate this knowledge into the appropriate action and to test out what works best and for whom. This is difficult at the present time because knowledge of stroke was not uniform across the populations studied. Perhaps this is why identifying the key components needed for an effective campaign aimed at reducing the delay in diagnosing and managing stroke is one of the top 10 priorities for stroke services research.

Improving public awareness about the signs of stroke was a key element of the UK Government's National Stroke Strategy. Consequently, the Department of Health is running a 3-year campaign aimed at raising public awareness of stroke. The findings from our review could be used to inform the campaign in terms of who should be targeted, how the information should be delivered and how often the message should be delivered. Our work has shown that older people and some minority groups tended to have less knowledge whilst at the same time being some of the most at risk groups. So while a general campaign covers a majority of the popula-

tion, it may be necessary to run campaigns that use media and language more appropriate to certain groups. The current campaign has used television and this has been shown to be effective [15]. However, the effect of awareness campaigns can be time limited and so it would be important to repeat the message. It has been suggested that intermittent, low-level advertising is as effective as continuous, high-level advertising [15]. Our findings suggest that the awareness campaign will need repeating, with an optimal time frame being around 3 months after the delivery of the first part of the campaign.

Those with lower levels of education [2, 6, 7] have consistently shown poor levels of stroke knowledge. Participants who had higher levels of education were more likely to name at least one symptom of stroke [7] or risk factor or to provide a correct explanation of the physiological processes of stroke. Higher levels of education and upper socio-economic status have also been associated with the ability to identify the brain as the organ affected by stroke. Other factors that affected knowledge were age and ethnicity. Older age groups had poorer knowledge of the risks factors [8, 9, 23] and symptoms of stroke [2, 9, 15, 23]. Inadequate risk factor knowledge was also more common among African Americans [6, 11, 16] and Hispanics [16].

These findings have parallels in other health topics where inadequate knowledge about a condition or service is often lower among ethnic minority groups and the less well educated [24]. For example, Caucasian women with some college education were more knowledgeable about breast cancer risk factors, symptoms, detection methods and treatment compared with people who had lower levels of education, or who were from ethnic minority groups. Ethnic minority groups have also been shown to be less likely to know about diabetes services available to them [24]. Why these particular groups have poorer levels of health knowledge is not fully understood.

Only one paper reported knowledge about treatment that could be given to stroke patients to break up blood clots [16]. Awareness of thrombolytic therapy was higher among Caucasians compared to Black or Hispanic respondents (92% versus 84% and 79%, respectively) [16].

Best way to educate

The next question is how to educate people. The review suggests that a television and newspaper advertising campaign improved recognition of stroke symptoms, whereas a newspaper campaign alone had no effect on symptom knowledge [15]. The most effective way to increase knowledge about stroke has been in stroke screening, educational programmes and first aid training [11]. Educational tools have also been shown to increase stroke awareness across diverse populations [11]. While it is appreciated that increasing knowledge does not necessarily lead to a change in behaviour, an increase in knowledge may facilitate behaviour change [25]. In order for us to increase knowledge and change behaviour, we need to consider which factors about stroke shape people's behaviours.

Health behaviour

Symptom recognition can be a major problem when studying illness behaviour, as symptoms often vary greatly from person to person. This has an obvious impact upon the clarity of cues to taking help-seeking action. The interpretation of symptoms may also vary according to situational influences [26]. Health action is influenced by an individual's state of readiness, beliefs shaped by personal, social and situational sources, as well as cues to action [25]. Programmes of health education should aim to minimise barriers to health services and provide cues to action [25]. Large proportions of people may be in a state of readiness but lack the information or the cues required to take appropriate action [25]. Public awareness programmes need to take into account levels of health knowledge in order to provide the information and cues that are necessary to influence behaviour [25]. This is particularly important in stroke given our findings that knowledge is dependent on variables such as age and ethnicity.

Limitations of the studies included

While telephone interviews were conducted, this approach to data collection excluded people with cognitive or communication deficits [27] and those who did not speak English [28]. Whilst risk factor identification and the recognition of stroke symptoms were often poor when open-ended questions were used, this appeared to improve when closed questions were asked. However, knowledge and awareness may have been overestimated by aided questions. Stroke awareness and knowledge may be more successfully evaluated using partially aided questions or vignettes to simulate more closely the situation of a person with a suspected stroke.

Limitations of the review

Our search may not have been exhaustive, but by combining several search strategies we suggest that most studies to date have been identified and included in this review. The review was limited to published studies, and publication bias may have influenced the results. This review focuses on studies that have evaluated knowledge of stroke and TIA. Although two studies evaluated the effects of a public education programme, other preventative programmes (reduction of blood pressure, smoking cessation programmes, exercise on prescription and healthful eating programmes) that may be used in conjunction with other conditions and diseases have not been included.

Summary

This review highlights the importance of increasing public awareness about stroke symptoms, risk factors and the emergency response that is required. Public awareness and education campaigns should be targeted towards those at risk of stroke, older members of the general population, eth-

nic minority groups and those with lower levels of education. These groups generally have lower levels of stroke knowledge, and yet stroke disproportionately impacts upon these groups [29]. There is a need for future research that identifies which interventions not only increase knowledge but also influence behaviour, and in what populations these interventions have the most impact.

Key points

- The most effective way to increase knowledge about stroke has been in stroke screening, educational programmes and first aid training.
- Levels of stroke knowledge are associated with age, education and ethnicity.
- Educational campaigns should target those groups who consistently demonstrate poorer knowledge of stroke.
- Asking questions may test knowledge, but they do not appear to reflect what a person does in real life, suggesting that alternative methods of testing knowledge need to be explored.

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Conflicts of interest

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Supplementary data

Supplementary data are available at *Age and Ageing* online.

The very long list of references supporting this review has meant that only the most important are listed here. The remaining references are available on the journal website http://www.ageing.oxfordjournals.org/ as Appendix 1.

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