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The recognition-response gap in acute stroke: examining the relationship between stroke recognition and response in a general population survey

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Abstract:	Background- Benefits of reperfusion therapies in acute ischemic stroke are highly time-dependent. It is crucial that people who witness the onset of symptoms call emergency medical services (EMS) immediately. The aim of this study was to examine whether there is a gap between recognition of stroke and responding correctly by calling EMS using a scenario-based measure. Methods- Population-based survey of 1,406 individuals from Newcastle upon Tyne, UK, examining stroke recognition and response knowledge using 12 scenario-based vignettes. The response rate was 32% out of 5,000 contacted individuals. In total, 16,574 responses to scenarios were examined to investigate whether respondents would recognise stroke symptoms and indicate to call EMS immediately. Results- In 16% of cases people recognised stroke but did not correctly respond by indicating to call EMS. In 49% of responses people recognised stroke and would respond correctly, while in 31% of cases people both failed to correctly recognise and failed to identify the correct response to the stroke scenario. In 5% of cases stroke was not identified but a correct response was indicated. When stroke was recognised, in 25% of responses people indicated that they would not call EMS. Recognition self-efficacy and response self-efficacy were associated with correct response. Conclusions- A recognition-response gap was identified among UK adults in hypothetical scenarios concerning stroke. Both recognition and translation to adequate EMS response should be explicitly addressed in interventions aiming to improve witness response to stroke. Self-efficacy may be a promising target to close the recognition-response gap.

Abstract

Background– Benefits of reperfusion therapies in acute ischemic stroke are highly time-dependent. It is crucial that people who witness the onset of symptoms call emergency medical services (EMS) immediately. The aim of this study was to examine whether there is a gap between recognition of stroke and responding correctly by calling EMS using a scenario-based measure.

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Conclusions– A recognition-response gap was identified among UK adults in hypothetical scenarios concerning stroke. Both recognition and translation to adequate EMS response should be explicitly addressed in interventions aiming to improve witness response to stroke. Self-efficacy may be a promising target to close the recognition-response gap.

Keywords: Stroke, delay, pre-hospital delay, behaviour, public health

Introduction

Stroke is one of the main causes of disability in the UK (1), but early reperfusion therapies such as thrombolysis and mechanical thrombectomy delivered to eligible patients can reduce the extent of disability (2). People frequently delay or avoid calling emergency medical services (EMS) following stroke onset, adding to pre-hospital delay of treatment (3). Evaluations of interventions aimed at increasing public knowledge of stroke symptoms and the need for an emergency response, such as the UK 'Act FAST' campaign (4), have produced mixed results concerning shorter pre-hospital delay times (5–7). Witnesses of stroke are often targeted by campaigns as they make 40-66% of decisions to call EMS for stroke patients (8). Understanding the cognitive process behind help-seeking behaviour for individuals who witness a stroke may improve the design of future educational interventions.

Improving witness response when someone has a stroke includes two processes: symptom recognition and initiating a rapid response by calling EMS (8, 9, see Figure 1). However, people who recognise stroke correctly but then fail to call EMS display a gap between recognition and response, which delays timely access to hyperacute stroke treatment. This recognition-response gap represents a public health education opportunity. Findings from population-based surveys suggest that some people fail to choose the adequate action despite knowing stroke symptoms or suspecting stroke (10,11). Although surveys have investigated stroke recognition and response separately, no study has systematically examined the presence and size of a recognition-response gap.

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The presence of a recognition-response gap in acute stroke would indicate that processes other than stroke knowledge and recognition might be relevant. According to social-cognitive models of health behaviour, such as the social-cognitive theory (12) or the health action process approach (13), self-efficacy, is an important determinant of behaviour (see Figure 1). Self-efficacy has been defined as people's beliefs in their capability to performing a task or an action (14). Studies have found that recognition self-efficacy (i.e. the belief in ones capability to recognise stroke) and response self-efficacy (i.e. the belief in ones capability to respond adequately to stroke) were related to correct stroke response in a scenario-based study (15). The present study will further disentangle links of stroke recognition, stroke recognition self-efficacy, and stroke response self-efficacy with correct EMS response to stroke scenarios.

This aim of this study is to examine a) whether a gap exists between recognition of stroke and responding correctly by calling EMS using a scenario-based measures; and b) whether stroke recognition self-effiacy and response self-efficacy play a role in witness response to acute stroke.

Methods

Participants, design and procedure

Population-based survey data were collected in 2012 from an adult general population sample in Newcastle upon Tyne, UK. Survey invitations informed individuals that by returning the questionnaires, they would indicate their consent to participate. Further details of the study population, design and procedure have been published previously (16). In brief, individuals (n=5,000) were selected at random from the electoral register and posted a questionnaire and a reminder card and questionnaire pack to non-responders after two and eight weeks respectively. Out of 5,000 contacted individuals, 1,615 (32%) returned the questionnaire. The ethics committee of the Faculty of Medical Sciences Ethical Newcastle University approved the study (ref no. 00550/2012).

Measures

Twelve stroke scenarios (e.g. ‘While out at the supermarket, you notice that the face of a family member suddenly looks droopy on one side’) and four non-stroke scenarios were presented and participants indicated if they thought the scenario symptoms were a stroke (*recognition*=‘potential stroke’, ‘not stroke’, ‘don't know’) and how they would respond to this situation (*response*=‘call the doctor's surgery’, ‘wait a couple of hours, then decide’, ‘call a family member or friend’, ‘call 999 [=*EMS*]’, ‘other’). The scenario-based measure was adapted from a validated US instrument (17). Recognition self-efficacy was measured by the item ‘I would be able to tell if someone was having a stroke’ (mean score 3.45, *SD*=0.82) and response self-efficacy by the item ‘If I saw someone having a stroke, I would know what to do’ (mean score 3.58, *SD*=1.01). Responses were made on a scale from *strongly disagree* (1) to *strongly agree* (5). Socio-demographic data used in the analysis were age, education (no formal qualifications, O-levels [= lower secondary education qualification], A-levels [= higher secondary education qualification], vocational training, degree), and quintiles of the Index of Multiple Deprivation (IMD; 18) 2015. The IMD is an indicator of “relative deprivation of small areas in England” (19), United Kingdom. Present analyses used quintiles of deprivation ranks from 1 (20% most deprived areas) to 5 (20% least deprived areas).

Statistical Analyses

Only stroke scenarios were used in the analysis. The 12 stroke scenario responses were categorised into four groups: a) stroke recognised and EMS response b) stroke recognised, but no EMS response, c) stroke not recognised, and EMS response, or d) stroke not recognised and no EMS response. After list-wise exclusion of missing data (3%), 16,574 scenario responses in 1,406 participants remained. To test whether recognition and self-efficacies were significantly associated with response, generalized linear (logit) mixed models were specified with correct response (0=no, 1=yes) to a stroke scenario as dependent variable and fully-crossed random effects for participant and scenario. Models were adjusted for age, deprivation, and education while testing associations with log-likelihood tests between models.

Results

Overall, 1,406 participants (mean age 53 years, *SD*=17, range=18-97, 57% female, 91% white) answered, in total, 16,574 recognition and response items of a stroke scenario. Response rate was 32% (n=1,615 participants returned questionnaire). Baseline characteristics of the analysis sample are depicted in Table 1.

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For the majority (49%, *n*=8,046) of stroke scenarios, participants recognised stroke and indicated an EMS response (see Table 2). In 16% (*n*=2,667) of stroke scenarios participants indicated no EMS response, despite correctly identifying stroke, indicating the presence of a recognition-response gap. In cases when stroke was recognised, 25% of responses indicated, people would not call EMS. Thirty percent (*n*=5,062) of stroke scenarios were not identified as stroke and participants indicated no EMS response. A few responses (5%, *n*=799) indicated an EMS response, even though stroke was not correctly identified.

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Recognition of stroke symptoms (*Est*=4.17, *SE*=0.11) was significantly associated with the correct EMS response when adjusting for socio-demographic variables (see Table 3), indicated by the generalized linear mixed model's improved fit to the data following the addition of recognition, $\chi^2(1)=1,602.10$, $p<.001$. When stroke was recognised, participants were 65 times (=Odds Ratio of *Est*=4.17) more likely to respond correctly to a stroke scenario compared to when stroke was not recognised. For scenarios correctly recognised as stroke, individuals (*n*=1,441) had indicated a mean of 5.76 correct subsequent EMS responses (*SD*=3.14, range 0-12, 10 individuals had no correct stroke recognition). Recognition self-efficacy (*Est*=0.10, *SE*=0.08) and response self-efficacy (*Est*=0.21, *SE*=0.07) were significantly associated with correct EMS response when adjusting for socio-demographic variables and correct recognition as stroke. This was indicated by improved model fit after separately adding recognition self-efficacy, $\chi^2(1)=13.60$, $p<.001$, and response self-efficacy, $\chi^2(1)=11.15$, $p<.001$, to the model.

[insert Table 3]

Discussion

In 16% of stroke scenarios people recognised stroke symptoms but failed to indicate an EMS response suggesting the presence of a recognition-response gap. When stroke was recognised, people were more likely to respond appropriately by indicating an EMS response. Those who failed to recognise stroke typically did not indicate an EMS response. Self-efficacy to recognise and respond to stroke play an additional role in the stroke response process. Public health education efforts need to continue to help people recognise stroke symptoms, whilst translating stroke recognition into an EMS response remains a pressing task.

This is the first study to examine recognition and response together within a scenario-based study. Other studies have examined stroke recognition and response separately and found that some individuals might recognise someone having a stroke, but still fail to respond appropriately (10,11). Our study underlines the key role of stroke recognition, and further suggests that in around 25% of cases, people would still fail to call EMS despite recognising a stroke. It remains unclear what keeps these people from applying their knowledge of stroke action. As previously reported (16), the majority indicates that they would call EMS when directly asked about stroke action. The presence of the recognition-response gap based on the scenarios indicates that additional determinants of behaviour might play a role in this process. As one social-cognitive determinant, we explored the role of self-efficacy.

The finding that recognition self-efficacy and response self-efficacy were important for correct EMS response supports previous research (15) which indicated that self-efficacy was associated with the behavioural intent to contact EMS in population-based samples in the US and UK. This study added to previous research as self-efficacy was shown to be linked to the correct response when accounting for recognition and socio-demographic factors. Self-efficacy might be an important social-cognitive variable involved in the process of stroke recognition and response process. Future research should try and promote self-efficacy to facilitate stroke recognition and response in future interventions. A recent church-based community intervention in the US was followed by an increased behavioural intent to contact EMS in a scenario-based measure immediately after the intervention and also after one month (21). The authors found indications that stroke recognition self-efficacy and response self-efficacy had improved, at both time points for recognition self-efficacy and immediately after the intervention for response self-efficacy. This suggests a possible pathway for future interventions via self-efficacy, but at the same time makes it clear that more specific information on how self-efficacy can be improved in the context of stroke response in witnesses is needed. Bandura stated that self-efficacy can be derived from four main sources, mastery experience, vicarious experience, persuasion, and interpreting one's emotional state (12). Intervention studies have been trying to translate these theory-related suggestions into actual program components to separate from each other what works and what does not. Evidence on effectivenessof mechanisms to change self-efficacy, e.g. by providing feedback on performance (22), were different for different health behaviour change contexts. The specific context of stroke response by witnesses needs to be taken into account when applying findings on possible intervention components to change self-efficacy and subsequently, behaviour.

This study has several limitations. The scenario-based vignette measure simulates real-life situations but is only a proxy measure of how people might behave if they needed to respond when someone has a stroke in real life. The response rate of 32% is a potential source of bias and could limit the confidence in our findings. Our sample included a higher proportion of socio-economically deprived people than people from most UK areas (19) limiting generalizability to the UK context and beyond. However, investigating a more deprived population might strengthen the value of the data as lower socio-economic status is related to longer pre-hospital delay of stroke (8) and higher stroke incidence (23).

Previous educational interventions, typically focused on improving stroke recognition, are often based on the acronym FAST which seeks to aid people in stroke recognition and response (4). Our data support the approach of attempting to improve stroke recognition. However, previous research suggests that although people seem to be able to remember the FAST acronym, they do not seem to apply it when faced with stroke symptoms (12). As evidence suggests that the focus on the need to call EMS can improve campaign impact (24), additional emphasis should be placed on helping individuals translate the stroke symptom awareness into EMS engagement behaviour. To overcome the perception that stroke is not treatable (25), campaigns should explain the rationale for needing to call EMS rapidly to access effective treatment options. Improving stroke recognition and reponse self-efficacy might be a fruitful target for future interventions.

In conclusion, stroke awareness raising interventions should explicitly focus on a) actively improving the recognition of symptoms indicative of acute stroke and b) translating recognition of stroke into a prompt EMS response to close the recognition-response gap.

Conflicts of interest

GAF, HR, and RGT have been involved in developing a computerized decision aid for thrombolytic treatment in acute stroke care. GAF has received personal remuneration for educational and advisory work from Boehringer Ingelheim (manufacturer of Alteplase) and Lundbeck. GAF's institution has received research grants from Boehringer Ingelheim. HR has received personal remuneration from Boehringer Ingelheim for educational work. GAF developed the Face Arm Speech Test (FAST) for use by ambulance paramedics in England. MW is Director of NIHR's Public Health Research Programme.

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Contributorship

FFS, MW, GAF, and SUD conceived the study. FFS, MW, SUD, VAS, RGT, HR, GAF, and JEM developed the methods. SUD and JM collected the data. LOW, SUD and PG planned the statistical analysis and LOW and GP conducted the analysis. Drafting of manuscript was done by LOW. SUD, PG, GAF, FFS, VAS, HR, RGT, MW, and JEM reviewed and added to the manuscript. All authors approved the final version.

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Figure legends

Figure 1. Model of elements of action for acute stroke, adapted from (8). In a situation, recognition of a health condition like stroke precedes the response. Knowledge on symptoms of stroke contributes to recognition, while response knowledge has an effect on the response such as calling emergency medical services (EMS). Recognition self-efficacy and response self-efficacy have an effect on stroke recognition or response behaviour. The recognition-response gap describes people recognising stroke but then failing to call EMS.

Abstract

Background– Benefits of reperfusion therapies in acute ischemic stroke are highly time-dependent. It is crucial that people who witness the onset of symptoms call emergency medical services (EMS) immediately. The aim of this study was to examine whether there is a gap between recognition of stroke and responding correctly by calling EMS using a scenario-based measure.

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This is the first study to examine recognition and response together within a scenario-based study. Other studies have examined stroke recognition and response separately and found that some individuals might recognise someone having a stroke, but still fail to respond appropriately (10,11). Our study underlines the key role of stroke recognition, and further suggests that in around 25% of cases, people would still fail to call EMS despite recognising a stroke. It remains unclear what keeps these people from applying their knowledge of stroke action. As previously reported (16), the majority indicates that they would call EMS when directly asked about stroke action. The presence of the recognition-response gap based on the scenarios indicates that additional determinants of behaviour might play a role in this process. As one social-cognitive determinant, we explored the role of self-efficacy.

The finding that recognition self-efficacy and response self-efficacy were important for correct EMS response supports previous research (15) which indicated that self-efficacy was associated with the behavioural intent to contact EMS in population-based samples in the US and UK. This study added to previous research as self-efficacy was shown to be linked to the correct response when accounting for recognition and socio-demographic factors. Self-efficacy might be an important social-cognitive variable involved in the process of stroke recognition and response process. Future research should try and promote self-efficacy to facilitate stroke recognition and response in future interventions. A recent church-based community intervention in the US was followed by an increased behavioural intent to contact EMS in a scenario-based measure immediately after the intervention and also after one month (21). The authors found indications that stroke recognition self-efficacy and response self-efficacy had improved, at both time points for recognition self-efficacy and immediately after the intervention for response self-efficacy. This suggests a possible pathway for future interventions via self-efficacy, but at the same time makes it clear that more specific information on how self-efficacy can be improved in the context of stroke response in witnesses is needed. Bandura stated that self-efficacy can be derived from four main sources, mastery experience, vicarious experience, persuasion, and interpreting one's emotional state (12). Intervention studies have been trying to translate these theory-related suggestions into actual program components to separate from each other what works and what does not. Evidence on effectivenessof mechanisms to change self-efficacy, e.g. by providing feedback on performance (22), were different for different health behaviour change contexts. The specific context of stroke response by witnesses needs to be taken into account when applying findings on possible intervention components to change self-efficacy and subsequently, behaviour.

This study has several limitations. The scenario-based vignette measure simulates real-life situations but is only a proxy measure of how people might behave if they needed to respond when someone has a stroke in real life. The response rate of 32% is a potential source of bias and could limit the confidence in our findings. Our sample included a higher proportion of socio-economically deprived people than people from most UK areas (19) limiting generalizability to the UK context and beyond. However, investigating a more deprived population might strengthen the value of the data as lower socio-economic status is related to longer pre-hospital delay of stroke (8) and higher stroke incidence (23).

Previous educational interventions, typically focused on improving stroke recognition, are often based on the acronym FAST which seeks to aid people in stroke recognition and response (4). Our data support the approach of attempting to improve stroke recognition. However, previous research suggests that although people seem to be able to remember the FAST acronym, they do not seem to apply it when faced with stroke symptoms (12). As evidence suggests that the focus on the need to call EMS can improve campaign impact (24), additional emphasis should be placed on helping individuals translate the stroke symptom awareness into EMS engagement behaviour. To overcome the perception that stroke is not treatable (25), campaigns should explain the rationale for needing to call EMS rapidly to access effective treatment options. Improving stroke recognition and reponse self-efficacy might be a fruitful target for future interventions.

In conclusion, stroke awareness raising interventions should explicitly focus on a) actively improving the recognition of symptoms indicative of acute stroke and b) translating recognition of stroke into a prompt EMS response to close the recognition-response gap.

Conflicts of interest

GAF, HR, and RGT have been involved in developing a computerized decision aid for thrombolytic treatment in acute stroke care. GAF has received personal remuneration for educational and advisory work from Boehringer Ingelheim (manufacturer of Alteplase) and Lundbeck. GAF's institution has received research grants from Boehringer Ingelheim. HR has received personal remuneration from Boehringer Ingelheim for educational work. GAF developed the Face Arm Speech Test (FAST) for use by ambulance paramedics in England. MW is Director of NIHR's Public Health Research Programme.

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Contributorship

FFS, MW, GAF, and SUD conceived the study. FFS, MW, SUD, VAS, RGT, HR, GAF, and JEM developed the methods. SUD and JM collected the data. LOW, SUD and PG planned the statistical analysis and LOW and GP conducted the analysis. Drafting of manuscript was done by LOW. SUD, PG, GAF, FFS, VAS, HR, RGT, MW, and JEM reviewed and added to the manuscript. All authors approved the final version.

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Figure legends

Figure 1. Model of elements of action for acute stroke, adapted from (8). In a situation, recognition of a health condition like stroke precedes the response. Knowledge on symptoms of stroke contributes to recognition, while response knowledge has an effect on the response such as calling emergency medical services (EMS). Recognition self-efficacy and response self-efficacy have an effect on stroke recognition or response behaviour. The recognition-response gap describes people recognising stroke but then failing to call EMS.

Figure 1 Click here to access/download;Figure(s);Figure_1_JSCD.png

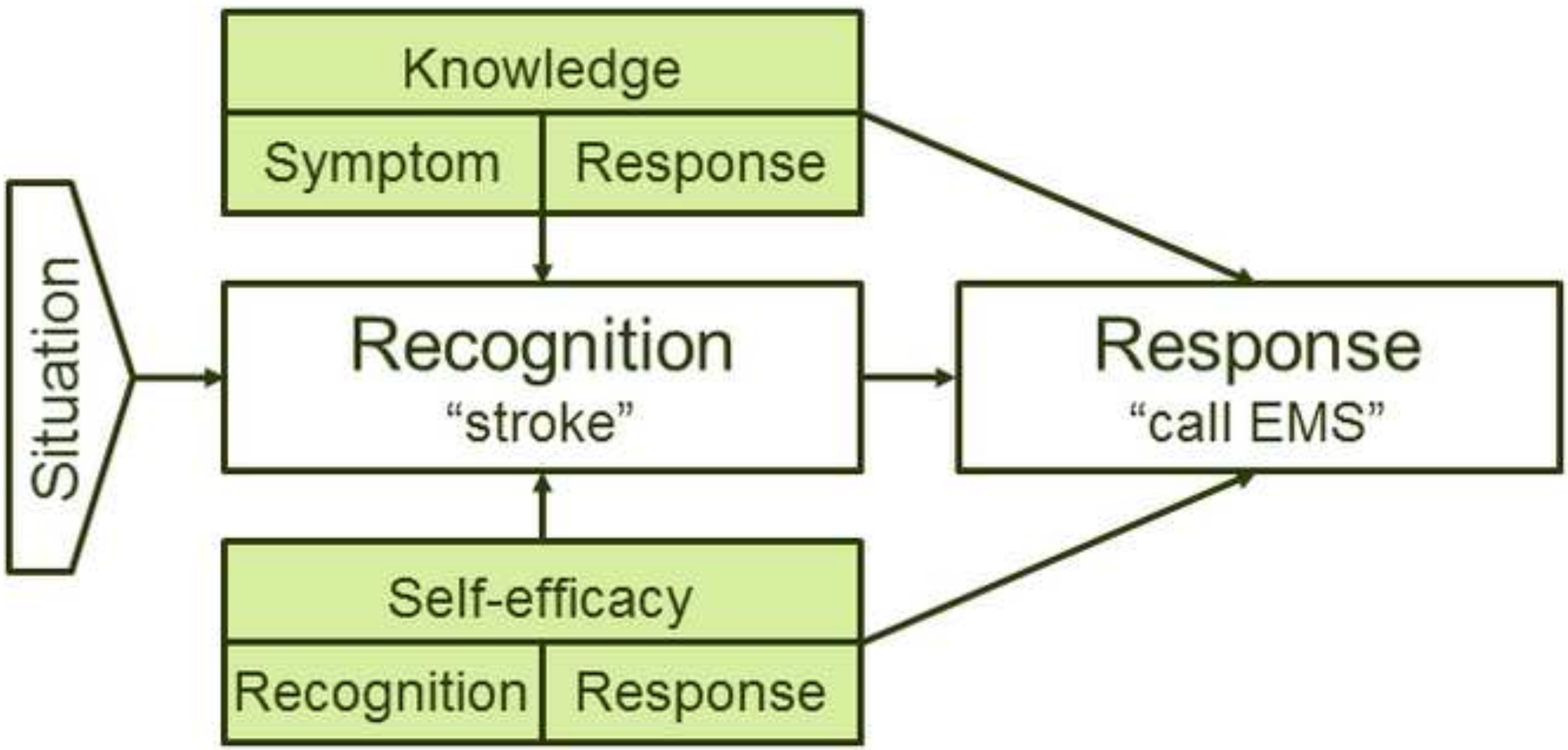

Table 1

Table 1. *Baseline characteristics (n=1,406).*

Variable	*M (SD)* / Frequency (% n)
Age	53.15 (16.9)
Gender (% women)	807 (57.4)
Ethnicity (% white British)	1284 (91.3)
Education[a], n (%)	
No professional qualification	329 (23.4)
O-levels	225 (16.0)
A-levels	105 (7.5)
Vocational training	353 (25.1)
Degree	394 (28.0)
IMD quintile[b], n (%)	
Quintile 1	400 (28.4)
Quintile 2	187 (13.3)
Quintile 3	185 (13.2)
Quintile 4	229 (16.3)
Quintile 5	405 (28.8)
Stroke history, n (%)	
Previous stroke (incl. TIA)	59 (4.2)
Witnessed stroke	202 (14.4)
Previous stroke in close social network	662 (47.1)
Past call to EMS (any reason)	585 (41.6)
Morbidities, n (%)	
Hypertension	249 (17.7)
Previous heart attack	54 (3.8)
Diabetes mellitus	111 (7.9)
Atrial fibrillation	35 (2.5)
Condition (% leaflet condition)	696 (49.5)

Note: IMD=Index of Multiple Deprivation. TIA=Transient Ischaemic Attack. EMS=Emergency Medical Services.

Table 2. Percentage and total number of responses to stroke scenarios indicating whether participants recognised stroke (No/Yes) and would initiate an emergency medical service response (No/Yes).

		Stroke recognition	
		No	Yes
EMS response	No	31% (5,062)	16% (2,667)
	Yes	5% (799)	49% (8,046)

Note: EMS = Emergency Medical Services. Figures based on *1,406 participants completing 16,574 valid scenarios*. Total percentage is 101 instead of 100 due to rounding.

Table 3_R

Table 3. *Generalized linear mixed model (N=16,574 observations) for binomial correct response as dependent variable and Laplace approximation estimation*

Variable	Model 1			Model 2			Model 3		
	Estimate (*SE*)	95% CI	OR	Estimate (*SE*)	95% CI	OR	Estimate (*SE*)	95% CI	OR
Fixed effects									
Intercept	-1.85 (0.38)	-2.59 – -1.11	0.16	-3.10 (0.40)	-3.87 – -2.32	0.05	-4.13 (0.47)	-5.04 – -3.21	0.02
Age	0.01 (0.00)	0.01 – 0.02	1.02	0.01 (0.00)	0.01 – 0.02	1.01	0.01 (0.00)	0.01 – 0.02	1.01
Education[a]									
O-levels	0.11 (0.16)	-0.20 – 0.41	1.11	0.10 (0.18)	-0.25 – 0.46	1.11	0.08 (0.18)	-0.27 – 0.44	1.09
A-levels	0.20 (0.21)	-0.21 – 0.62	1.23	0.08 (0.24)	-0.40 – 0.55	1.08	0.04 (0.24)	-0.44 – 0.51	1.04
Vocational training	0.05 (0.14)	-0.23 – 0.33	1.06	-0.03 (0.17)	-0.35 – 0.30	0.97	-0.08 (0.17)	-0.41 – 0.24	0.92
Degree	0.13 (0.16)	-0.18 – 0.44	1.14	-0.00 (0.18)	-0.36 – 0.35	1.00	-0.03 (0.18)	-0.38 – 0.33	0.97
IMD quintile[b]									
Quintile 2	-0.06 (0.15)	-0.36 – 0.24	0.94	-0.03 (0.18)	-0.37 – 0.32	0.97	-0.02 (0.18)	-0.36 – 0.33	0.98
Quintile 3	-0.22 (0.15)	-0.52 – 0.09	0.81	-0.18 (0.18)	-0.53 – 0.17	0.83	-0.21 (0.18)	-0.56 – 0.14	0.81
Quintile 4	-0.03 (0.14)	-0.31 – 0.25	0.97	-0.03 (0.17)	-0.36 – 0.30	0.97	-0.04 (0.17)	-0.37 – 0.29	0.96
Quintile 5	-0.10 (0.13)	-0.36 – 0.15	0.90	-0.11 (0.15)	-0.41 – 0.19	0.89	-0.11 (0.15)	-0.41 – 0.18	0.89
Recognition[c]				4.17* (0.11)	3.95 – 4.38	64.53	4.15* (0.11)	3.94 – 4.37	63.46
Recognition self-efficacy							0.10* (0.08)	-0.06 – 0.26	1.11

Response self-efficacy							0.21* (0.07)	0.08 – 0.34	1.23
Random effects									
Person variance (*n*=1,406)	2.22			2.13			2.29		
Scenario variance (*n*=12)	1.02			0.91			0.91		

Note: SE=Standard Error. CI=Confidence interval. OR=Odds Ratio. IMD=Index of Multiple Deprivation. [a]Reference education category: No formal qualification. [b]Reference IMD category: Quintile 1. [c]Reference recognition category: No recognition.

Unstandardized coefficient estimates are depicted.

Both models include participants and scenarios as fully-crossed random effects and a random slope for recognition for each participant. Additional covariates gender, ethnicity, and condition (leaflet vs. no leaflet) were tested but not found to improve model fit significantly.

*p<.001, based on log-likelihood-tests between Models 1 and 2, $\chi^2(1)$= 1,602.10, p<.001; Models 2 and 3a (Model 3, excluding response self-efficacy, not depicted in Table 3), $\chi^2(1)$= 13.60, p<.001; Models 3a and 3, $\chi^2(1)$= 11.15, p<.001. We chose log-likelihood-tests as the preferred way to test for significance of fixed effects in the generalized linear mixed models (20), even when the 95% confidence interval of a coefficient contained zero.