

Awareness of Stroke Risk Factors and Warning Signs and Attitude to Acute Stroke

ORIGINAL

Abstract

Background: Stroke is a leading cause of death and disability worldwide. Knowledge of stroke risk factors and warning signs might improve its prevention and ensure prompt activation of emergency medical services and access to thrombolysis. Educational campaigns have been held in Portugal though its impact on knowledge of medical patients has not been assessed.

Methods: A cross-sectional observational study was performed to medical outpatients, through an interview. Main objectives were to assess the extent of knowledge on risk factors and warning signs and the attitude to stroke and to identify predictive factors of stroke-related knowledge. Two sub-groups were studied: hypertensive and elderly.

Results: Two hundred and forty eight patients were randomly selected. Two hundred and nine patients (84.3%) spontaneously recalled at least one risk factor, most frequently hypertension, dyslipidemia and stress. One hundred and eighty four patients (74.2%) spontaneously named at least one warning sign, most frequently hemiparesis, speech impairment and facial palsy, but few (6.5%) spontaneously recalled the three together. One hundred and sixty nine patients would activate emergency medical service (69.5%). Hypertensive patients revealed a better stroke-related knowledge while no significant difference was found in elderly. Educational level was a predictor of better knowledge. Failure to activate emergency medical service was inversely associated to knowledge of risk factors, but not to warning signs.

Conclusion: Despite reasonable stroke-related knowledge, it is insufficient particularly concerning awareness of three main warning signs and behavior to acute stroke. Further investigation is necessary to identify barriers to activation of emergency medical service.

Ana Sofia Duque¹
Liliana Fernandes¹
Ana Filipa Correia¹
Inês Calvino¹
Gonçalo Cardoso¹
Marta Pinto¹
Patrícia Freitas¹
Joana Silvestre²
Vítor Batalha¹
Luís Campos¹

1 Medicine 4 Department, São Francisco Xavier Hospital, Occidental Lisbon Hospital Centre, Lisbon, Portugal.

2 Polivalent Intensive Care Unit, São Francisco Xavier Hospital, Occidental Lisbon Hospital Centre, Lisbon, Portugal.

Contact information:

Ana Sofia Duque.

Address: São Francisco Xavier Hospital – Medicine 4 Department, Estrada do Forte do Alto do Duque, 1449-005 Lisboa.

Tel: 00 351 21 043 10 00

Fax: 00 351 21 043 15 89.

✉ sofia.b.duque@gmail.com

Keywords

Stroke; Knowledge; Risk Factors; Signs and Symptoms; Attitude; Behavior, Medical Patients.

Introduction

Stroke is an important cause of death and disability worldwide [1]. In Portugal stroke is one of the leading causes of death, being mortality from stroke higher than ischemic heart disease mortality, unlike the European trend. Prevalence of ischemic stroke range from about 60% [2] to 85% among different populations, being ischemic stroke up to 10-times more frequent than hemorrhagic stroke in Western countries. [3]

Thrombolysis has shown to be an effective treatment for acute ischemic stroke within 4.5 hours of onset of ischemic stroke, improving clinical outcome [4, 5], not only reducing death but also dependency in activities of daily living [6]. The narrow therapeutic window of thrombolysis requires a prompt hospital arrival.

Several studies revealed that most acute stroke patients arrive too late to hospital [7-9], mainly due to delay in the decision to seek medical care following acute stroke symptoms onset [10, 11]. Prehospital delay might also occur because patients not activate emergency medical service but rather directly access emergency department, contact first a family member or the family doctor [12-14].

Previous studies have found that the public lack of knowledge of stroke warning signs [13-18] and risk factors as well as misunderstanding the concept "time is brain" might contribute to delay in responding to stroke as an emergency. Awareness of stroke warning signs might permit a faster recognition of stroke and immediate activation of prehospital emergency team [19]. Decrease in time from stroke onset to hospital arrival might increase the number of patients eligible to thrombolysis [19].

Knowledge of stroke risk factors might improve primary prevention [19], through lifestyle modification [20] and a more efficient control of cardiovascular risk factors. Previous studies have revealed that an important proportion of stroke high-risk patients are unaware of their risk [13, 16, 20-22].

The European Stroke Organization (ESO) suggests that educating the population to recognize stroke symptoms and changing people's attitudes to acute stroke, may reduce the delay from stroke onset to emergency medical service involvement [23].

Several educational interventions have been carried out worldwide in order to improve recognition of risk factors and warning signs of stroke. Nevertheless, its impact on changing behavior is poor [24, 25], despite increasing awareness of stroke warning signs.

Recently, an educational mass media campaign about stroke and myocardial infarction was carried out in Portugal [26]. A post-intervention study [27] revealed a reasonable knowledge of stroke warning signs by the overall population. However, the extent of knowledge was not studied in specific high risk groups. Some authors have considered that although mass media campaigns immediately improve stroke knowledge, awareness of stroke risk factors and symptoms declines post-intervention [28].

Worldwide several community-based studies have been performed to assess awareness of stroke risk factors, warning signs and attitudes intended to take when stroke is suspected [29]. Nevertheless, few studies were exclusively performed on medical outpatients [20, 30].

The aim of our study is to determine the knowledge of medical outpatients about stroke risk factors and warning signs as well as the attitude toward a suspected stroke. Subgroup analysis was undertaken in hypertensive and elderly patients.

Methods

This study was a cross-sectional, single center, observational study conducted during a 6 weeks period in the outpatient clinic of São Francisco Xavier Hospital during the year of 2011. São Francisco Xavier Hospital is a central and university hospital of

Lisbon, that belongs to an Hospital Centre serving a population of about 935.000 people as a tertiary referral center. In 2010 a total of about 18000 medical consultations were performed.

Patients were randomly selected while waiting for medical consultation in the waiting room. Verbal consent to participate in the study was obtained.

Patients were interviewed face-to-face about stroke risk factors and warning signs and attitude intended to acute stroke by two trained doctors. Each interviewer conducted a standardized, structured, one-to-one interview, according to a questionnaire designed to guide interview, avoiding bias. Patients were firstly elucidated about the aim of our study and confronted the several alternative designations of stroke. The interviewer intervened only if asked to clarify any question, though correct answers were not suggested.

The questionnaire was structured in 4 groups of questions. The translated version of the questionnaire is depicted in **figure 1**.

The first part included questions about stroke risk factors. An open-ended question was firstly performed, asking patients to name stroke risk factors. The remaining risk factors not spontaneously recalled were asked as closed-ended questions, integrated in a list of risk factors and diseases, which included 8 confounding conditions. The second part of the interview was about stroke warning signs, including also open-ended and closed-ended questions such as the first part.

The third part was about the attitude to acute stroke. The patient was inquired about the action that should be taken if a stroke was suspected through a multiple-choice question. Patients that answered to ask for medical care were inquired about the level of medical care that they would seek if a stroke was suspected, through a multiple-choice question as well.

The final question group concerned patient sociodemographic and clinical profile.

All interview data were recorded in a database.

Sub-group analysis of the hypertensive and elderly patients (65 or more years-old) were performed.

Statistical analysis

Descriptive and comparative statistical analysis were carried out using SPSS version 18.

Continuous variables were expressed as mean \pm standard deviation (SD) and 95% confidence interval (CI) for the mean. Categorical and ordinal variables were expressed as absolute frequency (n) and proportion (%) of the overall sample or subgroups.

Hypertensive and Non-Hypertensive and Elderly and Non-Elderly groups were compared. Continuous variables were compared using the T-Student test. Categorical variables were compared using the chi-square test and the Fisher's exact test.

Multivariate logistic regression with forwards stepwise selection was used to identify the influence of several sociodemographic and clinical characteristics on knowledge of stroke risk factors, warning signs and attitude to acute stroke of overall sample. The entry criterion for the multivariate model was $p \leq 0.05$. The receiver operating characteristics (ROC) area under the curve (AUC) was used to assess models discrimination.

Statistical tests were two-tailed and reported statistically significant at $p < 0.05$.

Results

A total of 252 patients were interviewed. Four questionnaires were excluded for incomplete data. Clinical and demographic data are presented in **table 1**.

One hundred and forty six patients were female (58.9%). The mean age was 60.56 ± 16.7 years-old (range 21 to 90 years-old). The mean number of stroke risk factors per patient was 4.44 ± 2.09 . The most prevalent stroke risk factors were hypertension (65.7%), dyslipidemia (57.7%), sedentary life style (57.7%) and stress (52%).

Figure 1:

AWARENESS OF STROKE RISK FACTORS AND WARNING SIGNS AND ATTITUDE TO ACUTE STROKE IN MEDICAL PATIENTS

| 1. STROKE RISK FACTORS | | |
|--|-------------------------|--|
| Q1a: Which conditions or life style habits may predispose to stroke? (open-ended question) | | Q1b: Within the following conditions, which may predispose to stroke? (read the following list, except those spontaneously recalled) (closed-ended question) |
| | Spontaneously recalled? | Identified? |
| Hypertension | Y N | Hypertension Gastric ulcer |
| Dyslipidemia | | Dyslipidemia Colitis |
| Diabetes | | Diabetes Constipation |
| Obesity | | Obesity Prostatic hypertrophy |
| Smoking | | Smoking Asthma |
| Sedentary life-style | | Sedentary life-style Bronchitis |
| Heavy alcohol consume | | Heavy alcohol consume Biliary lithiasis |
| Previous stroke | | Previous stroke Kidney lithiasis |
| Familiar hx of stroke | | Familiar history of stroke |

| 2. STROKE WARNING SIGNS | | |
|---|-------------------------|---|
| Q2a: Which are the signs of symptoms of acute stroke? (open-ended question) | | Q2b: Within the following signs and symptoms, which are present in acute stroke? (read the following list, except those spontaneously recalled) (closed-ended question) |
| | Spontaneously recalled? | Identified? |
| Speech impairment (dysarthria, aphasia) | Y N | Speech impairment (dysarthria, aphasia) Cough |
| Hemiparesis | | Hemiparesis Dyspnea |
| Facial palsy | | Facial palsy Abdominal ache |
| Dizziness / Vertigo | | Dizziness / Vertigo Chest pain |
| Paresthesia | | Paresthesia Diarrhea |
| Acute Headache | | Acute headache Fever |
| Visual alterations | | Visual alterations Dysuria |
| Confusion | | Confusion |

| 3. ATTITUDE TO ACUTE STROKE | |
|---|---|
| Q3a: What would you do if you suspected to be having a stroke? (multiple-choice question) | |
| 1. Wait and see | |
| 2. Ask for medical care next day | * |
| 3. Ask for medical care immediately | * |
| (*) Q3b: Which medical care level would you seek for? (multiple-choice question) | |
| 1. Primary health care | |
| 2. Emergency department | |
| 3. Emergency medical service | |

| 4. PATIENT IDENTIFICATION (complete and tick) | | | |
|---|----------------------|-----------------------------------|--|
| Gender F M | Age: _____ years-old | Education: years | |
| Hypertension | | Dyslipidemia | |
| Height: cm | Weight: Kg | BMI: | |
| Overweight | | Obesity | |
| Previous stroke | | Previous myocardial infarction | |
| Familiar hx stroke | | Familiar hx myocardial infarction | |

Table 1. Demographic and clinical profile of patients.

| Independent variables | Overall sample | Hypertensive patients | Non-hypertensive patients | Difference between hypertensive and non-hypertensive patients | Elderly patients | Non-Elderly patients | Difference between elderly and non-elderly patients |
|--------------------------------------|----------------|-----------------------|---------------------------|---|------------------|----------------------|---|
| | (n = 248) | (n = 163) | (n = 85) | | (n = 114) | (n = 134) | |
| Age (years) | | | | | | | |
| Mean±SD | 60.56 ± 16.7 | 65.7 ± 12.87 | 50.7 ± 18.68 | p<0.001 | 75.1 ± 7.05 | 48.19 ± 11.8 | p<0.001 |
| 95% CI | 58.48 – 62.65 | 63.7 – 67.68 | 46.7 – 54.76 | | 73.79 – 76.4 | 46.18 – 50.21 | |
| Median | 62 | 66 | 51 | p<0.001 | 75 | 51 | p<0.001 |
| Gender (n, %) | | | | | | | |
| Female | 146/58.9 | 90 / 55.2 | 56 / 65.9 | p = 0.135 | 63 / 55.3 | 83 / 61.9 | p = 0.303 |
| Male | 102 / 41.1 | 73 / 44.8 | 29 / 34.1 | | 51 / 44.7 | 51 / 38.1 | |
| Educational level (n %) | | | | | | | |
| 1 – 4 years | 73 / 29.7 | 53 / 32.7 | 20 / 23.8 | p = 0.013 | 45 / 39.8 | 28 / 21.1 | p < 0.001 |
| 5 – 9 years | 64 / 26.0 | 49 / 30.2 | 15 / 17.9 | | 35 / 31.0 | 29 / 21.8 | |
| 10 – 12 years | 56 / 22.8 | 32 / 19.8 | 24 / 28.6 | | 15 / 13.3 | 41 / 30.8 | |
| > 12 years | 45 / 18.3 | 22 / 13.6 | 23 / 27.4 | | 10 / 8.8 | 35 / 26.3 | |
| Stroke Risk Factors (RF) | | | | | | | |
| Number of RF per patient (mean ± SD) | 4.44 ± 2.09 | 5.29 ± 1.81 | 2.81 ± 1.57 | p<0.001 | 4.74 ± 1.90 | 4.19 ± 2.22 | p = 0.036 |
| Categories (n. %) | | | | | | | |
| 0 RF per patient | 6 / 2.4 | 0 / 0 | 6 / 7.1 | p<0.001 | 0 / 0 | 6 / 4.5 | p = 0.065 |
| 1-2 RF per patient | 39 / 15.7 | 9 / 5.5 | 30 / 35.5 | | 15 / 13.2 | 24 / 17.9 | |
| 3-4 RF per patient | 77 / 31.0 | 45 / 27.6 | 32 / 37.6 | | 35 / 30.7 | 42 / 31.3 | |
| > 4 RF per patient | 126 / 50.8 | 109 / 66.9 | 17 / 20.0 | | 64 / 56.1 | 62 / 66.3 | |

| Independent variables | Overall sample | Hypertensive patients | Non-hypertensive patients | Difference between hypertensive and non-hypertensive patients | Elderly patients | Non-Elderly patients | Difference between elderly and non-elderly patients |
|--|----------------|-----------------------|---------------------------|---|------------------|----------------------|---|
| | (n = 248) | (n = 163) | (n = 85) | | (n = 114) | (n = 134) | |
| Hypertension (n, %) | 163 / 65.7 | 163 / 100 | 0 / 0 | p < 0.001 | 94 / 82.5 | 69 / 51.5 | p < 0.001 |
| Dyslipidemia (n, %) | 143 / 57.7 | 118 / 72.4 | 25 / 29.4 | p < 0.001 | 77 / 67.5 | 66 / 49.3 | p = 0.005 |
| Diabetes (n, %) | 60 / 24.2 | 47 / 28.8 | 13 / 15.3 | p = 0.019 | 31 / 27.2 | 29 / 21.6 | p = 0.372 |
| Overweight (n, %) | 96 / 39.7 | 72 / 45.6 | 24 / 28.6 | p = 0.013 | 47 / 41.2 | 49 / 38.3 | p = 0.694 |
| Obesity (n, %) | 54 / 22.3 | 41 / 25.9 | 13 / 15.5 | p = 0.075 | 24 / 21.1 | 30 / 23.4 | p = 0.757 |
| Smoking (n, %) | 53 / 21.4 | 37 / 22.7 | 16 / 18.8 | p = 0.518 | 17 / 14.9 | 36 / 26.9 | p = 0.029 |
| Stress (n, %) | 129 / 52 | 84 / 51.5 | 45 / 52.9 | p = 0.894 | 46 / 40.4 | 83 / 61.9 | p = 0.001 |
| Sedentary life style (n, %) | 143 / 57.7 | 98 / 60.1 | 45 / 52.9 | p = 0.283 | 72 / 63.2 | 71 / 53.0 | p = 0.122 |
| Heavy alcohol consume (n, %) | 18 / 7.3 | 14 / 8.6 | 4 / 4.7 | p = 0.313 | 6 / 5.3 | 12 / 9.0 | p = 0.330 |
| Previous stroke (n, %) | 39 / 15.7 | 35 / 21.5 | 4 / 4.7 | p < 0.001 | 25 / 21.9 | 14 / 10.4 | p = 0.015 |
| Previous myocardial infarction (n, %) | 43 / 17.3 | 39 / 23.9 | 4 / 4.7 | p < 0.001 | 27 / 23.7 | 16 / 11.9 | p = 0.018 |
| Familiar history of stroke (n, %) | 91 / 36.7 | 65 / 39.9 | 26 / 30.6 | p = 0.167 | 48 / 42.1 | 43 / 32.1 | p = 0.114 |
| Familiar history of myocardial infarction (n, %) | 69 / 27.8 | 50 / 30.7 | 19 / 22.4 | p = 0.182 | 26 / 22.8 | 43 / 32.1 | p = 0.119 |

Knowledge of stroke risk factors (Table 2)

Of the ten stroke risk factors considered, each patient spontaneously recalled, in average, 2.24 ± 1.47 risk factors. Two hundred and nine patients (84.3 %) spontaneously recalled at least one stroke risk factor and 68.9% recalled two or more.

Hypertension, dyslipidemia and stress were the risk factors most frequently spontaneously recalled (43.5%, 34.7% and 28.6%, respectively). Diabetes was spontaneously recalled by only 15.4% and recognized by 62.9%. Diabetic patients identified more frequently diabetes as a stroke risk factor than non-diabetic patients (96.6% vs 72.7%, $p < 0.001$).

According to multiple logistic regression, knowledge (spontaneous recall) of at least 4 risk factors was related to presence of hypertension and higher educational level (Table 5).

Knowledge of stroke warning signs (Table 2)

Of the eight stroke warning signs considered, patients spontaneously recalled, in average, 1.60 ± 1.40 risk factors. One hundred and eighty four patients (74.2%) spontaneously named at least one stroke warning sign and 46.8% were able to name at least two.

The most common stroke warning signs recalled were hemiparesis, speech impairment and facial palsy (33.9%, 24.2% and 19.8%, respectively). Sixteen subjects (6.5%) spontaneously recalled speech impairment, hemiparesis and facial palsy simultaneously and 93.6% simultaneously recalled or identified these three warning signs, considered the three main warning signs of stroke.

Multiple logistic regression (Table 5) revealed that higher educational level and smoking were related to spontaneous recall of at least 4 stroke warning signs. Failure on identification or recognition of the three main stroke warning signs was related to previous myocardial infarction.

Table 2. Perception of stroke risk factors and warning signs –results for overall sample of medical patients.

| Independent variables | Overall sample | | |
|--|-----------------------|-------------------------|-----------------|
| | (n = 248) | | |
| | Open-ended question | Closed-ended question | Total |
| Risk Factors (RF) (n, %) | | | |
| Hypertension | 108 / 43.5 | 136 / 54.8 | 244 / 98.4 |
| Dyslipidemia | 86 / 34.7 | 156 / 62.9 | 242 / 97.6 |
| Diabetes | 38 / 15.4 | 156 / 62.9 | 194 / 78.5 |
| Obesity | 53 / 21.4 | 185 / 74.6 | 238 / 96 |
| Smoking | 64 / 25.8 | 176 / 71.0 | 240 / 96.8 |
| Stress | 71 / 28.6 | 165 / 66.5 | 236 / 95.2 |
| Sedentary life-style | 68 / 27.4 | 170 / 68.5 | 238 / 96 |
| Heavy alcohol consume | 61 / 24.6 | 170 / 68.5 | 231 / 93.1 |
| Previous stroke | 0 / 0 | 241 / 97.2 | 241 / 97.2 |
| Familiar hx stroke | 7 / 2.8 | 172 / 69.4 | 179 / 72.2 |
| Number of RF per patient | | | |
| Mean \pm SD | 2.24 ± 1.47 | 6.97 ± 1.55 | 9.21 ± 1.13 |
| 95% CI | 2.05 – 2.42 | 6.77 – 7.16 | 9.07 – 9.35 |
| Warning Signs (WS) (n, %) | | | |
| Dysarthria | 60 / 24.2 | 180 / 72.6 | 240 / 96.8 |
| Hemiparesis | 84 / 33.9 | 154 / 62.1 | 238 / 96 |
| Facial palsy | 49 / 19.8 | 197 / 79.4 | 246 / 99.2 |
| Dizziness / Vertigo | 39 / 15.7 | 189 / 76.2 | 228 / 91.9 |
| Paresthesia | 45 / 18.1 | 181 / 73 | 226 / 91.1 |
| Acute Headache | 39 / 15.7 | 177 / 71.4 | 216 / 87.1 |
| Visual alterations | 30 / 12.1 | 200 / 80.6 | 230 / 92.7 |
| Confusion | 46 / 18.5 | 190 / 76.6 | 236 / 95.1 |
| Dysarthria + Hemiparesis+ Facial palsy | 16 / 6.5 ^a | 216 / 87.1 ^b | 232 / 93.6 |

| Independent variables | Overall sample | | |
|--|---------------------|-----------------------|-----------------|
| | (n = 248) | | |
| | Open-ended question | Closed-ended question | Total |
| Number of WS per patient | | | |
| Mean \pm SD | 1.60 \pm 1.40 | 5.90 \pm 1.50 | 7.50 \pm 0.91 |
| 95% CI | 1.42 – 1.77 | 5.72 – 6.09 | 7.39 – 7.61 |
| Attitude (n, %) ^c | | | |
| Wait and see | ----- | ----- | 5 / 2 |
| Ask for medical care next day | ----- | ----- | 2 / 0.8 |
| Ask for medical care immediately | ----- | ----- | 241 / 97.2 |
| Level of Medical Care (n = 243) (n, %) ^c | | | |
| Primary health care | ----- | ----- | 4 / 1.6 |
| Emergency department | ----- | ----- | 70 / 28.8 |
| Emergency medical service | ----- | ----- | 169 / 69.6 |
| ^a Includes patients that spontaneously the 3 main warning signs | | | |
| ^b Includes patients that recognize the 3 main warning signs OR spontaneously name 1 warning sign and recognize 2 warning signs OR spontaneously name 2 warning signs and recognize 1 warning sign | | | |
| ^c Items assessed through multiple choice questions | | | |

Intended behavior in acute stroke

Faced with stroke suspicion two hundred and forty one patients (97.2%) would ask for medical care immediately: 169 (69.6%) would activate emergency medical service, 70 (28.8%) would directly get the emergency department and 4 (1.6%) would seek primary health care.

Multiple logistic regression (**Table 5**) revealed that no activation of emergency medical service when acute stroke is suspected was inversely associated to knowledge of stroke risk factors.

Subgroups Analysis

Hypertensive patients (Table 3)

One hundred and sixty three hypertensive patients were inquired and compared with non-hypertensive patients (n=85). Sociodemographic and clinical characteristics of hypertensive and non-hypertensive patients are resumed in **Table 1**.

Hypertensive patients revealed a better knowledge of stroke risk factors, identifying in average 9.37 ± 1.01 (vs 8.91 ± 1.30 in non-hypertensive patients, $p=0.005$). One hundred and forty hypertensive patients (85.9%) spontaneously recalled at least one risk factor (vs 81.2% in non-hypertensive patients, $p=0.361$). No difference was observed in recalling or recognizing each stroke risk factor between hypertensive and non-hypertensive patients. Knowledge of stroke warning signs was identical in both hypertensive and non-hypertensive patients. One hundred and twenty five hypertensive patients (76.7%) recalled at least one warning sign (vs 69.4%, $p = 0.224$). Recalling or recognition of each warning sign was identical in both groups.

Concerning attitude to acute stroke results were similar in both hypertensive and non-hypertensive.

Elderly patients (Table 4)

One hundred and fourteen elderly patients were inquired and compared with non-elderly patients (n=134). Sociodemographic and clinical profile of elderly and non-elderly patients are resumed in **Table 1**.

Elderly patients recalled in average a lower number of risk factors (1.82 ± 1.51) compared to non-elderly (2.59 ± 1.35 , $p<0.001$). On the other hand elderly patients identified an higher number of stroke risk factors (7.34 ± 1.67 vs non-elderly 6.65 ± 1.38 , $p=0.001$). Considering together results of both open- and closed-ended questions, there was no significant difference of number of stroke risk factors recalled or identified between elderly and non-elderly patients.

Table 3. Perception of stroke risk factors and warning signs – results for hypertensive and non-hypertensive groups.

| | Hypertensive patients | | | Non-hypertensive patients | | | Difference between hypertensive and non-hypertensive patients |
|---------------------------|-----------------------|-----------------------|-------------|---------------------------|-----------------------|-------------|---|
| | (n=163) | | | (n=85) | | | |
| | Open-ended question | Closed-ended question | Total | Open-ended question | Closed-ended question | Total | |
| Risk Factors (RF) (n,%) | | | | | | | |
| Hypertension | 76 / 46.6 | 85 / 52.1 | 161 / 98.7 | 32 / 37.6 | 51 / 60.0 | 83 / 97.6 | p = 0.350 |
| Dyslipidemia | 62 / 38.0 | 100 / 61.3 | 162 / 99.3 | 24 / 28.2 | 56 / 65.9 | 80 / 94.1 | p = 0.017 |
| Diabetes | 26 / 16.0 | 112 / 69.1 | 138 / 85.1 | 12 / 14.1 | 44 / 51.8 | 56 / 65.9 | p = 0.002 |
| Obesity | 36 / 22.1 | 122 / 74.8 | 158 / 96.9 | 17 / 20.0 | 63 / 74.1 | 80 / 94.1 | p = 0.545 |
| Smoking | 40 / 24.5 | 118 / 72.4 | 158 / 96.9 | 24 / 28.2 | 58 / 68.2 | 82 / 96.4 | p = 0.791 |
| Stress | 49 / 30.1 | 107 / 65.6 | 156 / 95.7 | 22 / 25.9 | 58 / 68.2 | 80 / 94.1 | p = 0.709 |
| Sedentary life-style | 44 / 27.0 | 112 / 68.7 | 156 / 95.7 | 24 / 28.2 | 58 / 68.2 | 82 / 96.4 | p = 0.944 |
| Heavy alcohol consume | 44 / 27.0 | 112 / 68.7 | 156 / 95.7 | 17 / 20.0 | 58 / 68.2 | 75 / 88.2 | p = 0.059 |
| Previous stroke | 0 / 0 | 160 / 98.2 | 160 / 98.2 | 0 / 0 | 81 / 95.3 | 81 / 95.3 | p = 0.196 |
| Familiar hx stroke | 5 / 3.1 | 117 / 71.8 | 122 / 74.9 | 2 / 2.4 | 55 / 64.7 | 57 / 67.1 | p = 0.423 |
| Number of RF per patient | | | | | | | |
| Mean ± SD | 2.34 ± 1.50 | 7.02 ± 1.54 | 9.37 ± 1.01 | 2.04 ± 1.39 | 6.86 ± 1.58 | 8.91 ± 1.30 | p = 0.005 ^a |
| 95% CI | 2.11 – 2.58 | 6.79 – 7.29 | 9.21 – 9.52 | 1.73 – 2.34 | 6.52 – 7.20 | 8.63 – 9.19 | |
| Warning Signs (WS) (n, %) | | | | | | | |
| Dysarthria | 36 / 22.1 | 123 / 75.5 | 159 / 97.6 | 24 / 28.2 | 57 / 67.1 | 81 / 95.3 | p = 0.317 |
| Hemiparesis | 54 / 33.1 | 103 / 63.2 | 157 / 96.3 | 30 / 35.3 | 51 / 60.0 | 81 / 95.3 | p = 0.855 |
| Facial palsy | 34 / 20.9 | 128 / 78.5 | 162 / 99.4 | 15 / 17.6 | 69 / 81.2 | 84 / 98.8 | p = 0.756 |
| Dizziness / Vertigo | 28 / 17.2 | 121 / 74.2 | 149 / 91.4 | 11 / 12.9 | 68 / 80.0 | 79 / 92.9 | p = 0.593 |
| Paresthesia | 32 / 19.6 | 113 / 69.3 | 145 / 88.9 | 13 / 15.3 | 68 / 80.0 | 81 / 95.3 | p = 0.137 |
| Acute Headache | 31 / 19.0 | 112 / 68.7 | 143 / 87.7 | 8 / 9.4 | 65 / 76.5 | 73 / 85.9 | p = 0.142 |
| Visual alterations | 21 / 12.9 | 132 / 81.0 | 153 / 93.9 | 9 / 10.6 | 68 / 80 | 77 / 90.6 | p = 0.584 |

| | Hypertensive patients | | | Non-hypertensive patients | | | Difference between hypertensive and non-hypertensive patients |
|--|-----------------------|-------------------------|-------------|---------------------------|------------------------|-------------|---|
| | (n=163) | | | (n=85) | | | |
| | Open-ended question | Closed-ended question | Total | Open-ended question | Closed-ended question | Total | |
| Confusion | 29 / 17.8 | 127 / 77.9 | 156 / 95.7 | 17 / 20.0 | 63 / 74.1 | 80 / 94.1 | p = 0.762 |
| Dysarthria + Hemiparesis + Facial palsy | 11 / 6.7 ^b | 142 / 87.1 ^c | 153 / 93.8 | 5 / 5.9 ^b | 73 / 85.9 ^c | 78 / 91.8 | p = 0.805 |
| Number of WS per patient | | | | | | | |
| Mean ± SD | 1.65 ± 1.42 | 5.86 ± 1.49 | 7.52 ± 0.81 | 1.49 ± 1.35 | 5.99 ± 1.52 | 7.48 ± 1.09 | p = 0.788 ^d |
| 95% CI | 1.43 – 1.87 | 5.63 – 6.09 | 7.39 – 7.64 | 1.20 – 1.79 | 5.66 – 6.32 | 7.25 – 7.72 | 24/17.9 |
| Attitude (n, %) ^e | | | | | | | |
| Wait and see | ----- | ----- | 3 / 1.8 | ----- | ----- | 2 / 2.4 | p = 0.572 |
| Ask for medical care next day | ----- | ----- | 2 / 1.2 | ----- | ----- | 0 / 0 | |
| Ask for medical care immediately | ----- | ----- | 158 / 96.9 | ----- | ----- | 83 / 97.6 | |
| Level of Medical Care (n = 243) (n, %) ^e | | | | | | | |
| Primary health care | ----- | ----- | 3 / 1.9 | ----- | ----- | 1 / 1.2 | p = 0.885 |
| Emergency department | ----- | ----- | 47 / 29.4 | ----- | ----- | 23 / 27.7 | |
| Emergency medical service | ----- | ----- | 110 / 68.8 | ----- | ----- | 59 / 71.1 | |
| ^a p value concerning comparison of number of risk factors spontaneously named or recognized per patient between hypertensive and non-hypertensive patients | | | | | | | |
| ^b Includes patients that spontaneously name the 3 main warning signs | | | | | | | |
| ^c Includes patients that recognize the 3 main warning signs OR spontaneously name 1 warning sign and recognize 2 warning signs OR spontaneously name 2 warning signs and recognize 1 warning sign | | | | | | | |
| ^d p value concerning comparison of number of warning signs spontaneously named or recognized per patient between hypertensive and non-hypertensive patients (column of Total) | | | | | | | |
| ^e Items assessed through multiple choice questions | | | | | | | |

Table 4. Perception of stroke risk factors and warning signs – results for elderly and non-elderly groups.

| | Elderly patients | | | Non-elderly patients | | | Difference between elderly and non-elderly patients |
|---------------------------|---------------------|-----------------------|-------------|----------------------|-----------------------|-------------|---|
| | (n=114) | | | (n=134) | | | |
| | Open-ended question | Closed-ended question | Total | Open-ended question | Closed-ended question | Total | |
| Risk Factors (RF) (n,%) | | | | | | | |
| Hypertension | 41 / 36.0 | 71 / 62.3 | 112 / 98.3 | 67 / 50.0 | 65 / 48.5 | 132 / 98.5 | p = 0.084 |
| Hypercholesterolemia | 37 / 32.5 | 74 / 64.9 | 111 / 97.4 | 49 / 36.6 | 82 / 61.2 | 131 / 97.8 | p = 0.789 |
| Diabetes | 11 / 9.7 | 78 / 69.0 | 89 / 78.7 | 27 / 20.1 | 78 / 58.2 | 105 / 78.3 | p = 0.065 |
| Obesity | 18 / 15.8 | 90 / 78.9 | 108 / 94.7 | 35 / 26.1 | 95 / 70.9 | 130 / 97.0 | p = 0.111 |
| Smoking | 18 / 15.8 | 91 / 79.8 | 109 / 95.6 | 46 / 34.3 | 85 / 63.4 | 131 / 97.7 | p = 0.003 |
| Stress | 34 / 29.8 | 73 / 64.0 | 107 / 93.8 | 37 / 27.6 | 92 / 68.7 | 129 / 96.3 | p = 0.594 |
| Sedentary life-style | 21 / 18.4 | 88 / 77.2 | 109 / 95.6 | 47 / 35.1 | 82 / 61.2 | 129 / 96.3 | p = 0.014 |
| Heavy alcohol consume | 26 / 22.8 | 80 / 70.2 | 106 / 93.0 | 35 / 26.1 | 90 / 67.2 | 125 / 93.3 | p = 0.833 |
| Previous stroke | 0 / 0 | 111 / 97.4 | 111 / 97.4 | 0 / 0 | 130 / 97.0 | 130 / 97.0 | p = 0.867 |
| Familiar hx stroke | 3 / 2.6 | 80 / 70.2 | 83 / 72.8 | 4 / 3.0 | 92 / 68.7 | 96 / 71.7 | p = 0.962 |
| Number of RF per patient | | | | | | | |
| Mean ± SD | 1.82 ± 1.51 | 7.34 ± 1.67 | 9.17 ± 1.23 | 2.59 ± 1.35 | 6.65 ± 1.38 | 9.25 ± 1.05 | p < 0.001 a / p = 0.001 b |
| 95% CI | 1.54 – 2.10 | 7.03 – 7.65 | 8.94 – 9.39 | 2.36 – 2.82 | 6.41 – 6.88 | 9.07 – 9.43 | |
| Warning Signs (WS) (n, %) | | | | | | | |
| Dysarthria | 21 / 18.4 | 88 / 77.2 | 109 / 95.6 | 39 / 29.1 | 92 / 68.7 | 131 / 97.8 | p = 0.111 |
| Hemiparesis | 32 / 28.1 | 78 / 68.4 | 110 / 96.5 | 52 / 38.8 | 76 / 56.7 | 128 / 95.5 | p = 0.165 |
| Facial palsy | 13 / 11.4 | 100 / 87.7 | 113 / 99.1 | 36 / 26.9 | 97 / 72.4 | 133 / 99.3 | p = 0.010 |
| Dizziness / Vertigo | 15 / 13.2 | 89 / 78.1 | 104 / 91.3 | 24 / 17.9 | 100 / 74.6 | 124 / 92.5 | p = 0.574 |
| Paresthesia | 15 / 13.2 | 88 / 77.2 | 103 / 90.4 | 30 / 22.4 | 93 / 69.4 | 123 / 91.8 | p = 0.17 |
| Acute Headache | 15 / 13.2 | 84 / 73.7 | 99 / 86.9 | 24 / 17.9 | 93 / 69.4 | 117 / 87.3 | p = 0.591 |
| Visual alterations | 14 / 12.3 | 94 / 82.5 | 108 / 94.8 | 16 / 11.9 | 106 / 79.1 | 122 / 91.0 | p = 0.536 |
| Confusion | 21 / 18.4 | 88 / 77.2 | 109 / 95.6 | 25 / 18.7 | 102 / 76.1 | 127 / 94.8 | p = 0.951 |

| | Elderly patients | | | Non-elderly patients | | | Difference between elderly and non-elderly patients |
|--|----------------------|-------------------------|-------------|-----------------------|-------------------------|-------------|---|
| | (n=114) | | | (n=134) | | | |
| | Open-ended question | Closed-ended question | Total | Open-ended question | Closed-ended question | Total | |
| Dysarthria + Hemiparesis+ Facial palsy | 5 / 4.4 ^c | 100 / 87.7 ^d | 105 / 92.1 | 11 / 8.2 ^c | 115 / 85.8 ^d | 126 / 94.0 | p = 0.416 |
| Number of WS per patient | | | | | | | |
| Mean ± SD | 1.32 ± 1.34 | 6.18 ± 1.48 | 7.50 ± 0.80 | 1.84 ± 1.40 | 5.66 ± 1.48 | 7.51 ± 1.00 | p = 0.003 ^e / p = 0.006 ^f |
| 95% CI | 1.07 – 1.56 | 5.91 – 6.46 | 7.35 – 7.65 | 1.60 – 2.08 | 5.41 – 5.92 | 7.34 – 7.68 | p = 0.017 |
| Attitude (n, %) ^g | | | | | | | |
| Wait and see | ----- | ----- | 2 / 1.8 | ----- | ----- | 3 / 2.2 | p = 0.296 |
| Ask for medical care next day | ----- | ----- | 2 / 1.8 | ----- | ----- | 0 / 0 | |
| Ask for medical care immediately | ----- | ----- | 110 / 96.5 | ----- | ----- | 131 / 97.8 | |
| Level of Medical Care (n = 243) (n, %) ^g | | | | | | | |
| Primary health care | ----- | ----- | 3 / 2.7 | ----- | ----- | 1 / 0.8 | p = 0.424 |
| Emergency department | ----- | ----- | 34 / 30.4 | ----- | ----- | 36 / 27.5 | |
| Emergency medical service | ----- | ----- | 75 / 67.0 | ----- | ----- | 94 / 71.8 | |
| ^a p value concerning comparison of number of risk factors spontaneously named per patient between elderly and non-elderly patients | | | | | | | |
| ^b p value concerning comparison of number of risk factors recognized per patient between elderly and non-elderly patients | | | | | | | |
| ^c Includes patients that spontaneously name the 3 main warning signs | | | | | | | |
| ^d Includes patients that recognize the 3 main warning signs OR spontaneously name 1 warning sign and recognize 2 warning signs OR spontaneously name 2 warning signs and recognize 1 warning sign | | | | | | | |
| ^e p value concerning comparison of number of warning signs spontaneously named per patient between elderly and non-elderly patients | | | | | | | |
| ^f p value concerning comparison of number of warning signs recognized per patient between elderly and non-elderly patients | | | | | | | |
| ^g Items assessed through multiple choice questions | | | | | | | |

Table 5. Multiple logistic regression: Factors related to: Knowledge of at least 4 stroke risk factors and warning signs, Failure on identification or recognition of 3 main stroke warning signs and No activation of emergency team when stroke is suspected (OR odds ratio).

| Predictors | OR (95% CI) | P | AUC (95%CI) |
|---|---------------------|--------|---------------------|
| Knowledge of at least 4 stroke risk factors ^a | | | |
| Hypertension | 2.324 (1.097-4.922) | 0.028 | 0.686 (0.603-0.769) |
| Education | 1.894 (1.392-2.577) | <0.001 | |
| Knowledge of at least 4 stroke warning signs ^a | | | |
| Education | 1.495 (1.026-2.179) | 0.036 | 0.693 (0.583-0.802) |
| Smoking | 2.908 (1.228-6.886) | 0.015 | |
| Failure on identification or recognition of 3 main stroke warning signs | | | |
| Previous myocardial infarction | 3.107 (1.075-8.981) | 0.036 | 0.596 (0.445-0.747) |
| No activation of emergency medical service when stroke is suspected | | | |
| Number of stroke risk factors spontaneously identified | 0.819 (0.677-0.992) | 0.041 | 0.571 (0.493-0.649) |
| ^a Spontaneous identification of stroke risk factors or warning signs | | | |

Concerning each stroke risk factor, the most commonly recalled were hypertension, dyslipidemia and stress. There were no significant differences in recalling each stroke risk factor between elderly and non-elderly except that smoking and sedentary life style were less spontaneously recalled by elderly. Nevertheless, when presented a list of stroke risk factors elderly were able to easily identify those two risk factors, such that global results of recalling and recognition of these two risk factors were similar in both age groups. Equally to the overall sample results, diabetes was the second least identified stroke risk "factors" (78.7%) by elderly.

Regarding stroke warning signs, elderly significantly recalled a lower number than non-elderly but identified a higher number of risk factors. No difference was noted considering recalling and recognition of stroke risk factors simultaneously between the two age groups. Seventy eight elderly patients (85.5%) identified at least one stroke warning sign (vs 88.7% of non-elderly patients, $p=0.06$). The most commonly recalled risk factors by elderly were hemiparesis (28.1%), speech impairment (18.4%)

and confusion (18.4%). Facial palsy was less often recalled by elderly (11.4% vs 26.9% by non-elderly, $p=0.010$). Although, considering the knowledge of the three main stroke warning signs together, despite a trend to a lower knowledge by elderly (4.4% vs 8.2%), no significant difference was observed between elderly and non-elderly.

Behavior intended to acute stroke was similar in both age groups.

Discussion

Our results reveal a good level of knowledge of stroke risk factors and warning signs within medical outpatients, better than that described in the majority of similar studies in the literature [19]. Greater awareness of stroke risk factors and warning signs might be motivated by the presence of medical comorbidity in patients we have studied while subjects included in most previous studies represent the general population.

In our study assessment of stroke risk factors and warning signs was performed through both open-

and closed-ended questions. Assessment of stroke related knowledge through closed-ended questions revealed an outstanding level of knowledge, which might overestimate the real level of knowledge, as revealed in previous studies [15, 31]. Consequently, we have focused analysis of results on data obtained through open-ended questions.

We found that 84.3% of patients spontaneously named at least one risk factor while most studies reported percentages that range 40 to 79% [13, 16, 18, 20, 32-41].

Hypertension and dyslipidemia were the most frequently named risk factors (43.5% and 34.7%). Other studies have already revealed that these two risk factors are among the most perceived as stroke risk factors [13, 16-18, 20, 29, 32, 38-40, 42-48].

Surprisingly, despite diabetes highly increases stroke risk, it was the second least recalled or identified stroke risk factor. Other studies have also reported poor recognition of diabetes as a risk factor for stroke [13, 16-18, 20, 32, 35, 41, 42, 47-50]. However, in our study diabetic patients were able to recognize their condition as a predisposing factor to stroke better than non-diabetic patients. Schneider et al have also reported that diabetic patients were more likely to name diabetes as a stroke risk factor than non-diabetic subjects [18]. Unawareness of importance of diabetes in stroke risk by diabetic patient was previously reported by Pancioli et al, with only 13% of diabetic patients recognizing diabetes as a major stroke risk factor [16].

Our data revealed that 74.2% of patients were able to name at least one warning sign while other community-based studies presented lower percentages that range 30 to 70% [16-18, 20, 28, 34-36, 38, 39, 45, 49, 51-54]. In our study only 46.8% of patients recalled two or more stroke warning signs while other studies have reported better identification of stroke warning signs [32, 40, 41]. However, most questionnaires used were based on closed-ended questions, which might overestimate the level of knowledge.

Similarly to previous studies [13, 14, 17, 32, 39-43, 45, 46, 48, 55, 56] hemiparesis, speech impairment and facial palsy were the most frequently recalled stroke warning signs in our study. However, only sixteen patients have spontaneously recalled the three main warning signs of stroke together, which might reveal inability to early identify stroke and immediately activate emergency medical services.

Multivariable logistic regression analysis revealed that education was associated to better knowledge of stroke risk factors and warning signs. This association was also reported in several studies performed in community [16-18, 29, 31, 32, 35-38, 43, 44, 49, 50, 57-62] and high-risk groups [20]. Hypertension was also associated to better stroke-related knowledge, similarly to previous studies [16, 18, 35]. Smoking was a predictor of better knowledge of stroke warning signs, which had been previously reported by Pancioli et al [16].

Concerning intended attitude to acute stroke we found that a significant proportion of patients would not activate emergency medical service facing stroke suspicion, which might hinder optimal stroke therapeutics, jeopardizing stroke outcome. Indeed, only 69.5% would activate emergency medical service. Becker [36] and Rowe [49] have reported very similar results concerning intended activation of emergency medical service, though several other authors have found better results reporting percentages of subjects seeking emergency medical care that range from 72 to 90% [13, 18, 25, 35, 50, 63, 64].

Furthermore, we believe these results overestimate the percentage that in the real scenario would activate emergency medical service as this topic was assessed through multiple-choice questions instead of open-ended questions. Some authors have also showed that despite adequate knowledge of stroke warning signs and intention to immediately activate emergency medical service, in the real scenario a significant number of patients would fail activation of emergency medical service [35, 65]. According to

ESO only 33-50% of patients recognize their own symptoms as stroke, which might explain the discrepancies between theoretical intended behavior to acute stroke and the reaction in case of an acute stroke [23].

Failure of activation of emergency medical service was inversely associated to knowledge of stroke risk factors, though association to knowledge of stroke warning signs was not found, as reported in other studies [39, 41, 60, 66].

Sub-group analysis of hypertensive patients revealed a better knowledge of stroke risk factors by hypertensive patients ($p=0.005$). Previous studies have already showed hypertension to be a good predictor of knowledge of stroke risk factors and warning signs [16-18, 47]. However, awareness of hypertension as a stroke risk factor was identical in hypertensive and non-hypertensive subjects, unlike previous studies that reported greater awareness by hypertensive subjects [16, 18]. Hypertensive patients revealed no trend to activate more the emergency medical service than non-hypertensive patients.

Sub-group analysis of elderly patients did not reveal unequivocal difference of knowledge of stroke risk factors and warning signs between both groups. Elderly revealed a worse performance in spontaneously recalling risk factors and warning signs; on the other hand elderly patients revealed a better performance in identifying risk factors and warning signs within a list. Memory decline that frequently occurs with aging might explain the difficulty in spontaneously recalling risk factors and warning signs. Indeed, considering global results regarding number of risk factors and warning signs identified in both open- and closed-ended questions, there was no significant difference of knowledge between elderly and non-elderly. Other studies showed that age is a predictor of lower knowledge of stroke risk factors and warning signs, regardless of the type of questions used [13, 15-18, 21, 29, 31, 35, 39, 52, 60, 62]. Such as in our study, Carroll et al have reported

no influence of age on the level of knowledge of stroke [13].

Elderly inquired presented a better stroke-related knowledge than in other studies. We found that each risk factor and warning sign inquired was recognized (or even spontaneously recalled) by more than 70% of elderly patients, while Hickey et al [40] have reported that most stroke risk factors and warning signs were recognized by less than 50% of elderly patients. Hypertension, dyslipidemia and stress were the three most frequently identified risk factors in our study, similar to data presented by Hickey et al [40]. Although some studies have demonstrated association of older age and correct activation of acute emergency service [41, 66], in our study there was no difference of behavior to acute stroke between elderly and non-elderly patients.

Unlike other studies [13, 16, 17, 20, 22, 53, 67], we did not find poorer stroke knowledge in the two highest risk groups studied. Hypertensive and elderly patients revealed identical knowledge of stroke warning signs compared to non-hypertensive and non-elderly patients, respectively. Hypertensive patients even revealed better knowledge of stroke risk factors.

Limitations of our study are mainly related to relatively small sample size and being a single-centre study. However, our study used both open- and closed-ended questions. We believe that none of the both methods corresponds to real knowledge as the first one underestimates and the latter overestimates. Another advantage of our study was personal contact between the interviewers and the participants as it ensure greater reliability in comprehension of the questionnaire and authenticity of the answers obtained.

Conclusions

To our knowledge this is the first Portuguese study that assessed awareness of stroke risk factors and warning signs and correct behavior to acute stroke

of medical outpatients. We consider that development of adequate stroke prevention and treatment strategies requires an assessment of stroke-related knowledge, not only of general public but also of high-risk groups. Therefore, results of this study might be useful in targeting future public or high-risk groups educational campaigns, according knowledge deficits identified.

Ability to spontaneously recall the three main stroke warning signs must be improved, as well as intended activation of emergency medical service to acute stroke. Overall stroke knowledge must be improved in diabetic and elderly patients.

There was no association between failure to activate emergency medical service and knowledge of warning signs. Therefore, further investigation is necessary to identify barriers responsible for the incorrect behavior to acute stroke, despite adequate knowledge of stroke warning signs.

Conflict of interest

No conflict of interests to declare.

References

- Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. *Lancet* 2006; 367: 1747-57.
- Shiber JR, Fontane E, Adewale A. Stroke registry: hemorrhagic vs ischemic strokes. *The American journal of Emergency Medicine* 2010; 28: 331-3.
- Andersen KK, Olsen TS, Dehlendorff C, Kammersgaard LP. Hemorrhagic and ischemic strokes compared: stroke severity, mortality, and risk factors. *Stroke* 2009; 40: 2068-72.
- Hacke W, Kaste M, Bluhmki E, et al. Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke. *The New England Journal of Medicine* 2008; 359: 1317-29.
- Wahlgren N, Ahmed N, Davalos A, et al. Thrombolysis with alteplase 3-4.5 h after acute ischaemic stroke (SITS-ISTR): an observational study. *Lancet* 2008; 372: 1303-9.
- Wardlaw JM, Murray V, Berge E, Del Zoppo GJ. Thrombolysis for acute ischaemic stroke. *Cochrane Database of Systematic Reviews* 2009: CD000213.
- Harraf F, Sharma AK, Brown MM, Lees KR, Vass RI, Kalra L. A multicentre observational study of presentation and early assessment of acute stroke. *BMJ* 2002; 325: 17.
- Salisbury HR, Banks BJ, Footitt DR, Winner SJ, Reynolds DJ. Delay in presentation of patients with acute stroke to hospital in Oxford. *QJM* 1998; 91: 635-40.
- Johnston F, Wardlaw J, Dennis MS, et al. Delays in stroke referrals. *Lancet* 1999; 354: 47-8.
- Keskin O, Kalemoglu M, Ulusoy RE. A clinic investigation into prehospital and emergency department delays in acute stroke care. *Medical Principles and Practice* 2005; 14: 408-12.
- Chang KC, Tseng MC, Tan TY. Prehospital delay after acute stroke in Kaohsiung, Taiwan. *Stroke* 2004; 35: 700-4.
- Wein TH, Staub L, Felberg R, et al. Activation of emergency medical services for acute stroke in a nonurban population: the T.L.L. Temple Foundation Stroke Project. *Stroke* 2000; 31: 1925-8.
- Carroll C, Hobart J, Fox C, Teare L, Gibson J. Stroke in Devon: knowledge was good, but action was poor. *Journal of Neurology, Neurosurgery and Psychiatry* 2004; 75: 567-71.
- Lecouturier J, Murtagh MJ, Thomson RG, et al. Response to symptoms of stroke in the UK: a systematic review. *BMC Health Services Research* 2010; 10: 157.
- Jones SP, Jenkinson AJ, Leathley MJ, Watkins CL. Stroke knowledge and awareness: an integrative review of the evidence. *Age and Ageing* 2010; 39: 11-22.
- Pancioli AM, Broderick J, Kothari R, et al. Public perception of stroke warning signs and knowledge of potential risk factors. *JAMA* 1998; 279: 1288-92.
- Reeves MJ, Hogan JG, Rafferty AP. Knowledge of stroke risk factors and warning signs among Michigan adults. *Neurology* 2002; 59: 1547-52.
- Schneider AT, Pancioli AM, Khoury JC, et al. Trends in community knowledge of the warning signs and risk factors for stroke. *JAMA* 2003; 289: 343-6.
- Stroebele N, Muller-Riemenschneider F, Nolte CH, Muller-Nordhorn J, Bockelbrink A, Willich SN. Knowledge of risk factors, and warning signs of stroke: a systematic review from a gender perspective. *International Journal of Stroke* 2011; 6: 60-6.
- Al Shafae MA, Ganguly SS, Al Asmi AR. Perception of stroke and knowledge of potential risk factors among Omani patients at increased risk for stroke. *BMC Neurology* 2006; 6: 38.
- Samsa GP, Cohen SJ, Goldstein LB, et al. Knowledge of risk among patients at increased risk for stroke. *Stroke* 1997; 28: 916-21.
- Gupta A, Thomas P. Knowledge of stroke symptoms and risk factors among at-risk elderly patients in the UK. *International Journal of Clinical Practice* 2002; 56: 634-7.
- Guidelines for management of ischaemic stroke and transient ischaemic attack 2008. *Cerebrovascular Diseases* 2008; 25: 457-507.

24. Lecouturier J, Rodgers H, Murtagh MJ, White M, Ford GA, Thomson RG. Systematic review of mass media interventions designed to improve public recognition of stroke symptoms, emergency response and early treatment. *BMC Public Health* 2010; 10: 784.
25. Marx JJ, Nedelmann M, Haertle B, Dieterich M, Eicke BM. An educational multimedia campaign has differential effects on public stroke knowledge and care-seeking behavior. *Journal of Neurology* 2008; 255: 378-84.
26. Guidelines on Emergency Pathways of Myocardial Infarction and Cerebral Vascular Accident-Portuguese Office of the High Commissioner for Health-National Coordinating Body for Cardiovascular Disease. Vol. 2011, 2007.
27. Branco MJ, Nunes B. Warning signs of myocardial infarction and stroke: A note on knowledge and attitudes. Portuguese National Health Institute Doutor Ricardo Jorge. Lisbon, 2007.
28. Hodgson C, Lindsay P, Rubini F. Can mass media influence emergency department visits for stroke? *Stroke* 2007; 38: 2115-22.
29. Pontes-Neto OM, Silva GS, Feitosa MR, et al. Stroke awareness in Brazil: alarming results in a community-based study. *Stroke* 2008; 39: 292-6.
30. Wahab KW, Okokhere PO, Ugheoke AJ, Oziegbe O, Asalu AF, Salami TA. Awareness of warning signs among suburban Nigerians at high risk for stroke is poor: a cross-sectional study. *BMC Neurology* 2008; 8: 18.
31. Nicol MB, Thrift AG. Knowledge of risk factors and warning signs of stroke. *Vascular Health and Risk Management* 2005; 1: 137-47.
32. Pandian JD, Jaison A, Deepak SS, et al. Public awareness of warning symptoms, risk factors, and treatment of stroke in northwest India. *Stroke* 2005; 36: 644-8.
33. Muller-Nordhorn J, Nolte CH, Rossnagel K, et al. Knowledge about risk factors for stroke: a population-based survey with 28,090 participants. *Stroke* 2006; 37: 946-50.
34. Segura T, Vega G, Lopez S, Rubio F, Castillo J. Public perception of stroke in Spain. *Cerebrovascular Diseases* 2003; 16: 21-6.
35. Sug Yoon S, Heller RF, Levi C, Wiggers J, Fitzgerald PE. Knowledge of stroke risk factors, warning symptoms, and treatment among an Australian urban population. *Stroke* 2001; 32: 1926-30.
36. Becker K, Fruin M, Gooding T, Tirschwell D, Love P, Mankowski T. Community-based education improves stroke knowledge. *Cerebrovascular Diseases* 2001; 11: 34-43.
37. Gongora-Rivera F, Gutierrez-Jimenez E, Zenteno MA. Knowledge of ischemic stroke among a Mexico City population. *Journal of Stroke and Cerebrovascular Diseases* 2009; 18: 208-13.
38. Gutierrez-Jimenez E, Gongora-Rivera F, Martinez HR, Escamilla-Garza JM, Villarreal HJ. Knowledge of ischemic stroke risk factors and warning signs after a health education program by medical students. *Stroke* 2011; 42: 897-901.
39. Kothari R, Sauerbeck L, Jauch E, et al. Patients' awareness of stroke signs, symptoms, and risk factors. *Stroke* 1997; 28: 1871-5.
40. Hickey A, O'Hanlon A, McGee H, et al. Stroke awareness in the general population: knowledge of stroke risk factors and warning signs in older adults. *BMC Geriatrics* 2009; 9: 35.
41. Mikulik R, Bunt L, Hrdlicka D, Dusek L, Vaclavik D, Kryza J. Calling 911 in response to stroke: a nationwide study assessing definitive individual behavior. *Stroke* 2008; 39: 1844-9.
42. Truelsen T, Krarup LH. Stroke awareness in Denmark. *Neuroepidemiology* 2010; 35: 165-70.
43. Falavigna A, Teles AR, Vedana VM, et al. Awareness of stroke risk factors and warning signs in southern Brazil. *Arquivos de Neuro-Psiquiatria* 2009; 67: 1076-81.
44. Novak EM, Zetola Vde H, Muzzio JA, Puppi M, Carraro Junior H, Werneck LC. [Lay knowledge about stroke]. *Arquivos de Neuro-Psiquiatria* 2003; 61: 772-6.
45. Rau R, Mensing M, Brand H. [Community knowledge about stroke. A survey in the District of Wesel, Germany (2002)]. *Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz* 2006; 49: 450-8.
46. Derex L, Adeleine P, Nighoghossian N, Honnorat J, Trouillas P. [Knowledge about stroke in patients admitted in a French Stroke Unit]. *Revue Neurologique* 2004; 160: 331-7.
47. Sug Yoon S, Heller RF, Levi C, Wiggers J. Knowledge and perception about stroke among an Australian urban population. *BMC Public Health* 2001; 1: 14.
48. Kim JS, Yoon SS. Perspectives of stroke in persons living in Seoul, South Korea. A survey of 1000 subjects. *Stroke* 1997; 28: 1165-9.
49. Rowe AK, Frankel MR, Sanders KA. Stroke awareness among Georgia adults: epidemiology and considerations regarding measurement. *Southern Medical Journal* 2001; 94: 613-8.
50. Alkadry MG, Wilson C, Nicholson D. Stroke awareness among rural residents: the case of West Virginia. *Social Work in Health Care* 2005; 42: 73-92.
51. Blades LL, Oser CS, Dietrich DW, et al. Rural community knowledge of stroke warning signs and risk factors. *Preventing Chronic Disease* 2005; 2: A14.
52. Neau JP, Ingrand P, Godeneche G. Awareness within the French population concerning stroke signs, symptoms, and risk factors. *Clinical Neurology and Neurosurgery* 2009; 111: 659-64.
53. De Dominicis L, Cardinali P, Pucci E, et al. What do Italians at high risk of stroke know about ischaemic stroke? A survey among a group of subjects undergoing neuro-sonographic examination. *Neurological sciences : official journal of the Italian Neurological Society and of the Italian Society of Clinical Neurophysiology* 2006; 27: 7-13.
54. Hux K, Rogers T, Mongar K. Common perceptions about strokes. *Journal of Community Health* 2000; 25: 47-65.

55. Park MH, Jo SA, Jo I, et al. No difference in stroke knowledge between Korean adherents to traditional and western medicine-the AGE study: an epidemiological study. *BMC Public Health* 2006; 6: 153.
56. Evci ED, Memis S, Ergin F, Beser E. A population-based study on awareness of stroke in Turkey. *European Journal of Neurology* 2007; 14: 517-22.
57. Kamran S, Bener AB, Deleu D, et al. The level of awareness of stroke risk factors and symptoms in the Gulf Cooperation Council countries: Gulf Cooperation Council stroke awareness study. *Neuroepidemiology* 2007; 29: 235-42.
58. Miller JE. Knowledge of stroke risk factors, symptoms, and treatment among New Jersey adults. *New Jersey Medicine* 2001; 98: 47-53.
59. Parahoo K, Thompson K, Cooper M, Stringer M, Ennis E, McCollam P. Stroke: awareness of the signs, symptoms and risk factors--a population-based survey. *Cerebrovascular Diseases* 2003; 16: 134-40.
60. Oro M, Sanahuja-Montesinos J, Hernandez L, Seto E, Purroy F. [The extent of knowledge about strokes among the population of a rural area in the province of Lleida]. *Revista de Neurologia* 2009; 48: 515-9.
61. Nedeltchev K, Fischer U, Arnold M, Kappeler L, Mattle HP. Low awareness of transient ischemic attacks and risk factors of stroke in a Swiss urban community. *Journal of Neurology* 2007; 254: 179-84.
62. Greenlund KJ, Neff LJ, Zheng ZJ, et al. Low public recognition of major stroke symptoms. *American journal of Preventive Medicine* 2003; 25: 315-9.
63. Fogle CC, Oser CS, Troutman TP, et al. Public education strategies to increase awareness of stroke warning signs and the need to call 911. *Journal of Public Health Management and Practice* 2008; 14: e17-22.
64. Jurkowski JM, Maniccia DM, Dennison BA, Samuels SJ, Spicer DA. Awareness of necessity to call 9-1-1 for stroke symptoms, upstate New York. *Preventing Chronic Disease* 2008; 5: A41.
65. Fussman C, Rafferty AP, Lyon-Callo S, Morgenstern LB, Reeves MJ. Lack of association between stroke symptom knowledge and intent to call 911: a population-based survey. *Stroke* 2010; 41: 1501-7.
66. Schroeder EB, Rosamond WD, Morris DL, Evenson KR, Hinn AR. Determinants of use of emergency medical services in a population with stroke symptoms: the Second Delay in Accessing Stroke Healthcare (DASH II) Study. *Stroke* 2000; 31: 2591-6.
67. Chaturvedi S, Femino L. A pilot study regarding knowledge of stroke risk factors in an urban community. *Journal of Stroke and Cerebrovascular Diseases* 1997; 6: 426-9.

Comment on this article:



<http://medicalia.org/>

Where Doctors exchange clinical experiences, review their cases and share clinical knowledge. You can also access lots of medical publications for free. **Join Now!**

Publish with iMedPub

<http://www.imed.pub>

International Archives of Medicine is an open access journal publishing articles encompassing all aspects of medical science and clinical practice. IAM is considered a megajournal with independent sections on all areas of medicine. IAM is a really international journal with authors and board members from all around the world. The journal is widely indexed and classified Q1 in category Medicine.