

Stroke knowledge in two highly educated populations in Mexico City

Fernando López-Alvis^{1*}, Raúl E. Valdés-Galván¹, Eduardo Soriano-Navarro¹, Rodrigo González-Oscoy¹, Fernando Espinosa-Lira¹, Erwin Chiquete-Anaya², and Antonio Arauz¹

¹Stroke Clinic, Instituto Nacional de Neurología y Neurocirugía; ²Department of Neurology, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán. Mexico City, Mexico

Abstract

Background/Objective: Stroke knowledge is variable within and between countries. It is determined by school grade, geographical location, and language barriers. This study aims to evaluate the knowledge of stroke symptoms, risk factors, and treatment in a specific population in Mexico. **Methods:** We surveyed volunteer participants among the inhabitants of a medium-income condominium complex and employees of a pharmaceutical company located in Mexico City between 2016 and 2018. We collected information regarding knowledge of stroke definitions, symptoms, risk factor identification, and treatment. **Results:** We surveyed 499 participants at both sites, with a median age of 44 years (interquartile range 31-70) and mean years of education of 16.09 years (SD 3.67). The recognition of different definitions regarding stroke was highly heterogeneous, with "brain hemorrhage" and "stroke" being the most known. Among participants, 70% knew at least one stroke symptom. Out of four risk factors, a mean of 3 are identified when prompted, with dyslipidemia being the least acknowledged. While 70% of participants recognize stroke as treatable, only 12-25% know about intravenous thrombolysis. There was no significant difference in overall stroke knowledge between surveyed sites. **Conclusions:** Knowledge about stroke remains highly heterogeneous in our population. While the knowledge of the general presentation of stroke is higher than in other studies, probably due to the higher mean school education, the awareness of treatment options is low. New public education programs should consider including this information, because it may improve the proportion of cases treated promptly.

Keywords: Stroke. Knowledge. Health education. Risk factors. Signs.

Conocimiento de la enfermedad vascular cerebral en la Ciudad de México

Resumen

Introducción/Objetivo: El conocimiento de la enfermedad vascular cerebral (EVC) varía entre países y dentro de los mismos. Está determinado por la escolaridad, localización geográfica, barreras de lenguaje y más. Este estudio proporciona información reciente sobre este tema, a través de la medición del conocimiento sobre los síntomas de la EVC, factores de riesgo y tratamientos, en una población de la Ciudad de México. **Métodos:** Realizamos una entrevista a participantes voluntarios en un condominio de ingreso medio y a empleados de una empresa farmacéutica en Ciudad de México, entre 2016 y 2018. Recolectamos información acerca del conocimiento de definiciones de EVC, síntomas, factores de riesgo y tratamientos. **Resultados:** Realizamos 499 entrevistas entre ambos sitios, con mediana de edad de 44 años (intercuartile range 31-70) y

*Correspondence:

Fernando López-Alvis
E-mail: fer.lopez.alvis@gmail.com

Date of reception: 27-07-2023

Date of acceptance: 05-09-2023

DOI: 10.24875/RMN.23000045

Available online: 06-11-2023

Rev Mex Neuroci. 2023;24(6):179-184

www.revexneurociencia.com

2604-6180 / © 2023 Academia Mexicana de Neurología A.C. Published by Permanyer. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

media de escolaridad de 16.09 años (SD 3.67). El reconocimiento de diferentes definiciones relacionadas a la EVC fue altamente heterogéneo, siendo “hemorragia cerebral” y “EVC” los más reconocidos. Adicionalmente, 70% reconoció al menos 1 síntoma de EVC. De 4 factores de riesgo, se identificaron una media de 3, siendo dislipidemia el menos reconocido. Aunque el 70% reconoce la EVC como tratable, sólo un 12-25% conoce la trombolisis intravenosa. No hubo diferencia significativa entre ambos sitios. **Conclusiones:** El conocimiento de la EVC permanece altamente heterogéneo en nuestra población. Mientras el conocimiento sobre la presentación de la EVC fue mayor a otros estudios, probablemente por una mayor escolaridad, el conocimiento del tratamiento es bajo. Los programas de educación deben considerar incluir esta información, ya que puede mejorar la proporción de casos tratados en tiempo oportuno.

Palabras clave: Enfermedad vascular cerebral. Conocimiento. Educación en salud. Factores de riesgo. Signos.

Introduction

Accounting for 85% of all stroke-related deaths worldwide, acute stroke is a significant public health problem, especially for countries undergoing epidemiological transition¹. In Mexico, stroke is the seventh leading cause of death, with over 19,000 deaths in 2021². Stroke is also a leading cause of disability in adults and the second most common cause of dementia. Given its impact on the economically active population and quality of life, improving stroke prevention and treatment must be of high priority for public health-care systems worldwide.

Acute stroke can present with multiple signs and symptoms, usually affecting one side of the body and potentially associated with decreased alertness³. Sometimes, its initial presentation is subtle and may not be recognized by bystanders. There has been substantial effort to strengthen the recognition of stroke among health-care personnel and the general population⁴; however, specific studies regarding its impact in Mexico have yet to be conducted⁵.

Stroke prevention is more cost-efficient than treatment. This is done through modifiable risk factors control, such as a healthy diet, physical activity, and pharmacological treatment⁶. Acute reperfusion treatments (intravenous thrombolysis or mechanical thrombectomy) have improved functional outcomes; however, these therapies can only be applied in certain scenarios and within a specific timeframe. In Mexico, 66% of stroke patients arrive at a hospital after 6 h of symptom onset, reducing the chances of successful reperfusion therapy¹. In a recent Mexican study, 17.4% of patients arrived < 4.5 h, and only 7.6% received intravenous thrombolysis⁷.

Stroke knowledge varies worldwide and even within countries⁸, with up to 70% recognition of at least one symptom and one risk factor. Among the Mexican population, information regarding public knowledge of acute stroke treatments is lacking⁹. Increased stroke

knowledge could lead to earlier recognition of stroke and potentially increase the proportion of patients arriving in time for reperfusion therapy. Our study provides updated information about stroke knowledge in the general population.

Materials and methods

For this study, we designed a questionnaire addressing stroke knowledge, including its definition and associated concepts, risk factors, symptoms, and treatments. This questionnaire was divided into six different sections: (1) knowledge of different terms used by non-healthcare professionals to name “stroke;” (2) definition of common terms associated with stroke; (3) recognition of the main clinical manifestations of stroke; (4) recognition of risk factors for stroke; (5) knowledge of acute treatment of stroke; and (6) perceived stroke mortality.

The first section consisted of applicants answering all the terms they knew in Spanish that were equivalent to stroke, which is very variable among native Spanish speakers. In the second, we asked the participants to define in their own words different terms related to “stroke” (“brain infarction,” “brain hemorrhage,” “subarachnoid hemorrhage,” “cerebral venous thrombosis,” “transient ischemic attack,” and “aneurysm”). In the third, we asked the participants to answer all the symptoms they knew of stroke openly, and we compared the answers to a pre-established list; if they did not name any of these pre-established symptoms, we prompted the responses, and we requested them to answer “yes” or “no.” In the fourth part, we provided a list of risk factors for stroke, including four correct risk factors (hypertension, diabetes, dyslipidemia, and obesity) and six wrong answers (sexually transmitted disease [STD], pregnancy, hepatitis, asthma, cataract, gastritis), to which participants answered “yes” or “no” if they considered it to be associated with increased stroke risk. Finally, we investigated whether they recognized stroke as a treatable disease, the correct treatments they knew about, and whether they were aware of intravenous

thrombolysis and mechanical thrombectomy. In the condominium-complex group, the questionnaire included the following questions: “Do you know how much time we have to administer the thrombolytic therapy after the first symptom?” and “Out of 100 patients suffering from stroke, how many do you think will die?” These questions were not asked in the pharmaceutical company survey to reduce bias because these data are included in sales strategies. The complete survey is provided as supplementary material.

We trained 4th-year medical students in the systemized application of the survey, who then applied the survey to willing participants aged 18 years and older, under supervision from the authors. The survey was applied in two locations in Mexico City: A middle-class condominium complex (Villa Olímpica – a condominium complex in the south of Mexico City and close to the National Autonomous University of Mexico – inhabited by several researchers from this University), and the headquarters of a pharmaceutical company (producers of Alteplase).

The permit was submitted to the authorities of each site to survey inhabitants and workers. We had permission accepted in 2016 by the condominium and in 2018 by the pharmaceutical company. Each site was surveyed over 2 days, the first (condominium complex) in December 2016 and the second (pharmaceutical company) in August 2018. We do not consider that the conduction of the survey in two different years poses a risk for different degrees of knowledge, given that no promotion or educational program for stroke existed or was promoted in those years in Mexico City. The questionnaire was applied to all volunteer inhabitants at the condominium in a door-to-door search, and in the pharmaceutical company, we only applied it to non-medical administrative personnel, which included employees of the sales, accounting, and marketing departments.

The permit was submitted to the authorities of each site to survey inhabitants and workers. We had permission accepted in 2016 by the condominium and in 2018 by the pharmaceutical company. Each site was surveyed over 2 days, the first (condominium complex) in December 2016 and the second (pharmaceutical company) in August 2018. We devised a composite score, ranging from 0 to 12 points, to summarize and compare results between groups. Surveys with missing data were excluded from the study.

Statistical analysis

Categorical variables are presented as frequencies with proportions; normality testing for continuous

variables was performed using the Kolmogorov–Smirnov test; these variables are reported as median with interquartile range (IQR) or as mean with standard deviation as appropriate; differences between non-normally distributed variables were tested using the Mann–Whitney U-test for independent samples, to compare the composite score results between surveyed groups and Spearman's rho for exploring the correlation between age and education level with composite score results. Analyses were performed using IBM SPSS Statistics version 20 (IBM Corp., Armonk, NY, USA).

Results

In total, we surveyed 535 people, excluding 36 surveys due to being incomplete. [Table 1](#) summarizes results from 499 participants, with 277 in the condominium complex group (median age 58 years [IQR 43-70]; 55% female; mean years of education 16.7 [SD 4.40]) and 222 in the company's building (median age 33 [IQR 27-42] years; 54.9% male; mean years of education 15.3 [SD 2.28]). Age was higher in the condominium complex group, and the educational level was significantly lower among the company group.

Regarding stroke concepts, half of the participants correctly defined stroke and cerebral infarction. Brain hemorrhage was the most correctly defined concept in 68.7%, but subarachnoid hemorrhage and transient ischemic attack were the lowest (8% and 9.6%, respectively). Brain aneurysm, a concept commonly associated with stroke in Spanish laypeople language, was correctly defined only in 18.4%.

The recognition of initial stroke symptoms was good overall, with 71% recognizing at least one sign and 53.7% recognizing two or more. Perhaps, the downside point is that a third part of the participants could not identify any symptoms. The complete Cincinnati triad was only mentioned by 13.2%, possibly due to our country's need for a specific stroke education program. True risk factors were extensively recognized in all participants, and false risk factors were rarely recognized, besides pregnancy and STD which were referred to as risk factors by approximately a fifth of participants.

Stroke treatment knowledge was higher in the company than in the condos, which is expected since they produce Alteplase. Despite this, 75.8% of participants could not mention a single treatment for stroke. When applying the composite score, there was no statistically significant difference between the groups' overall stroke knowledge.

Table 1. Result summary

Variable	Group 1: condominium (n = 277) (%)	Group 2: company (n = 222) (%)	Total (n = 499) (%)
Age in years	56 (43-70)	33 (27-42)	44 (31-60)
Male sex	107 (45.1)	130 (54.9)	237 (47.5)
Years of education	16.71 (4.40)	15.31 (2.28)	16.09 (3.67)
Familiarized with stroke, (%)	156 (56.3)	101 (45.5)	257 (51.5)
Defined brain infarction	141 (50.9)	79 (35.6)	220 (44.1)
Defined brain hemorrhage	196 (70.8)	147 (66.2)	343 (68.7)
Defined SAH	26 (9.4)	14 (6.3)	40 (8.0)
Defined CVT	87 (31.4)	62 (27.9)	149 (29.9)
Defined TIA	34 (12.3)	14 (6.3)	48 (9.6)
Defined brain aneurysm	77 (27.8)	15 (6.8)	92 (18.4)
Stroke symptom knowledge			
0	102 (36.8)	40 (18.0)	142 (28.5)
1	42 (15.2)	47 (21.2)	89 (17.8)
2 or more	133 (48.0)	135 (60.8)	268 (53.7)
Mentioned cincinnati triad	42 (15.2)	24 (10.8)	66 (13.2)
Identified true risk factors	3.07 (1.18)	2.92 (1.10)	3.00 (1.15)
Identified false risk factors	0.96 (1.31)	0.81 (1.09)	0.89 (1.21)
Recognized stroke as treatable	195 (70.4)	156 (70.3)	351 (70.3)
Identified stroke treatments			
0	217 (78.3)	161 (72.5)	378 (75.85)
1	48 (17.3)	55 (24.85)	103 (20.6)
2 or more	12 (4.3)	6 (2.7)	18 (3.6)
Defines IVT	35 (12.6)	56 (25.2)	91 (18.2)
Composite score	6 (4-8) p = 0.861	6 (4-8)	6 (4-8)

*Age and composite score described in median and IQR; education level, true risk factors recognized, and false risk factors recognized are described in mean and standard deviation.: Independent samples Mann–Whitney U-test. Composite score: Defines brain infarction (1 point), defines brain hemorrhage (1 point), recognizes Cincinnati triad (1 point), number of stroke symptoms recognized (none = 0 points, 1 = 1 point, 2 or more = 2 points), true risk factors identified (1 point per each), number of stroke treatments known (none = 0 points, 1 = 1 point, 2 or more = 2 points), defines IVT (1 point).
SAH: subarachnoid hemorrhage; CVT: cerebral venous thrombosis; TIA: transient ischemic attack; IV: intravenous thrombolysis.

Figure 1 describes the recognized proportion of surveyed risk factors. Hypertension was the most recognized risk factor, with 95%, while dyslipidemia was the least known risk factor with 60%. Although no false risk factor was recognized more than any true ones, unrelated diseases such as cataracts can be identified as such when suggested.

In the extended version of the questionnaire for the condominium group (n = 277), we obtained the following responses. Regarding the window time to administer thrombolytics, we obtained 48 responses (17.3%), of which 36 (75%) considered a window to apply thrombolytics < 3 h, 1 (2.08%) between 3 and 4.5 h, and 11 (22.9%) > 4.5 h. Furthermore, in this group, the average perceived mortality from stroke was 39.7% (0-100) with 122 participants (44%) reporting < 30% mortality,

93 (33.5%) between 30 and 60%, and the remaining 62 (22.3%) > 60%.

We found no correlation between age and composite score (p = 0.92), with a weak correlation (0.230) between education level and composite score (p < 0.001).

Discussion

This study found that stroke knowledge in these selected Mexican populations remains heterogeneous, ranging from a greater understanding of risk factor recognition to a deficient knowledge of stroke definitions and treatments. It is worthwhile to compare the overall results with those obtained by Góngora-Rivera et al. in 2003, also obtained in a median-income population in Mexico City⁹. Knowledge of at least one stroke symptom was higher in our study

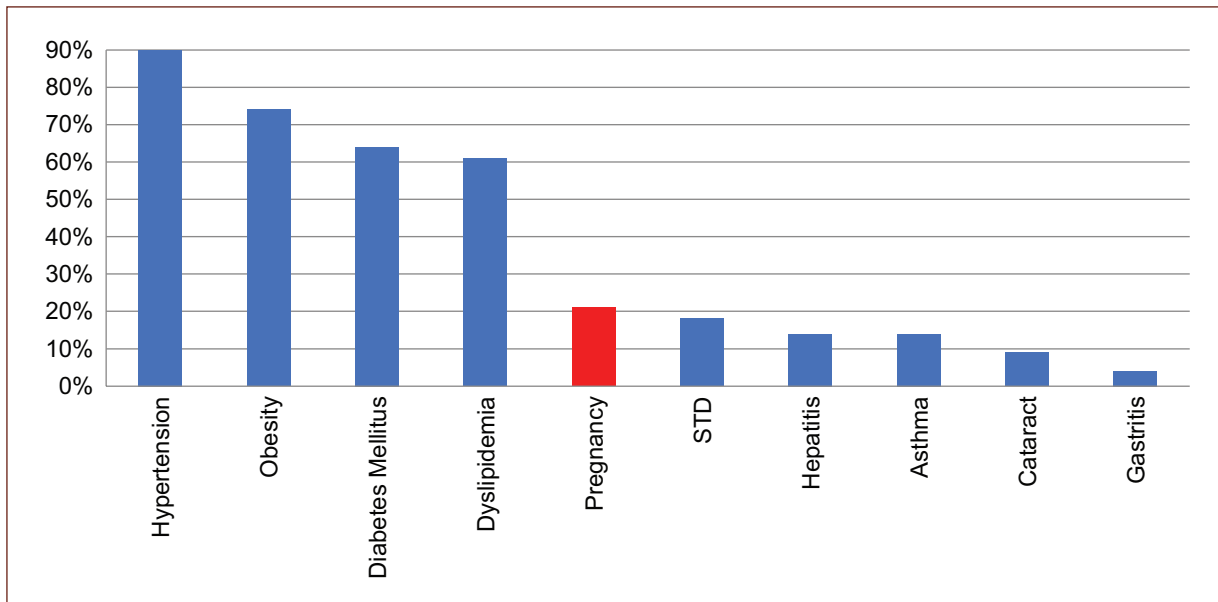


Figure 1. True (blue) and false (red) risk factors recognized by participants in %.

(33% vs. 60%). The proportion of risk factor recognition was also higher in our study; however, the differences in methodology could explain this finding (prompted answers vs. open questions). The use of distractors (false risk factors) was only used in our study, demonstrating a low recognition of these compared to the actual risk factors, and indicating a low level of misinformation in this area.

The lack of universal terminology in Spanish for stroke makes it difficult to establish public information programs to recognize acute stroke signs and symptoms accurately. This factor may contribute to the poor knowledge among our population¹⁰. Most of our population uses different terms to name a stroke. However, as demonstrated in our questionnaire, they lack a deeper understanding of these diverse concepts. This language barrier problem represents a challenge for developing stroke education programs in Spanish-speaking countries¹¹. This may not be exclusive to the Spanish-speaking population, as this remains understudied. As an example, some of the interviewed population refer to hemorrhage as “*derrame*” (“blood spillover”). They may also consider it a synonym of “aneurysm,” and both terms are at least as commonly used by the general population. It is essential to recognize this lingual disparity when comparing the knowledge of stroke between diverse language-speaking people, and critical for creating and promoting adequate education programs, which cannot be the same for all.

The recognition of presenting stroke symptoms was far greater than in earlier studies in our city⁹. For example, the percentage of people able to recognize one

alarm symptom was almost double. The proportion of recognition of initial symptoms was also high compared to similar studies in other Latin American countries. In Colombia, an open-ended questionnaire demonstrated that 65% could not name an initial stroke symptom, and 54% could not name a risk factor¹². In Brazil, 22% could not mention any presenting symptom, closer to the proportion found in our study¹³. Given differences in methodology, these comparisons must be interpreted with caution; however, they could be explained by greater years of education in our selected population. Paralysis on one side of the body and mouth deviation is the most recognized symptoms; moreover, other important presenting symptoms such as coma or acute visual disturbances were less in this study.

One crucial point in our study, which has not been previously searched for in our country and is only seldom investigated in other survey-based studies, is the knowledge of thrombolytic and interventional therapies for stroke and the existence of a window time. It has been previously demonstrated that knowledge of these points is low among the general population¹⁴. Another important fact is that understanding risk factors and stroke presentation may not be associated with a higher proportion of patients arriving in window time, as found in an interview study in Brazil¹⁵. This has also been observed even among the more exposed to stroke population of health-care professionals. This could mean that there is not enough divulgation of these problems among the general population, but it

could also represent the more complex nature of these terms. Directing efforts toward increasing knowledge in these areas may be helpful¹⁶. In a study done in patients hospitalized for acute stroke, the factors associated with arrival within the window time for IVT were recognition of the first symptom as part of the stroke, the use of an ambulance, and the knowledge of the existence of a thrombolytic therapy^{17,18}.

The variation in survey years could introduce bias, as the prominence of mechanical thrombectomy may have increased during that period. Despite the absence of any promoted educational programs for stroke treatment in Mexico City during those years, we cannot guarantee that company personnel remained uninformed on this matter, and we recognize this as a limitation in this study.

Conclusion

Knowledge of stroke, in general, is determined by years of education and the language-specific terms for stroke at the general population level. Despite the greater general knowledge with increasing years of schooling, the knowledge of thrombolytic therapies and time windows for reperfusion therapies was low even among our educated population. We hope that our data could be helpful in the development of public education programs, aiming at creating information directed in lay language (but unified) terms, and about the importance of very early hospital arrival in functional outcomes and prognosis.

Acknowledgments

The authors thank the students of the Faculty of Medicine of Universidad La Salle who helped carry out the interviews.

Funding

The authors declare that this work was carried out with the authors' own resources.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Use of artificial intelligence for generating text. The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript, nor for the creation of images, graphics, tables, or their corresponding captions.

Supplementary data

Supplementary data are available at DOI: 10.24875/RMN.23000045. These data are provided by the corresponding author and published online for the benefit of the reader. The contents of supplementary data are the sole responsibility of the authors.

References

1. Cantú-Brito C, Ruiz-Sandoval JL, Murillo-Bonilla LM, Chiquete E, León-Jiménez C, Arauz A, et al. Acute care and one-year outcome of Mexican patients with first-ever acute ischemic stroke: the PREMIER study. *Rev Neurol*. 2010;5:641-9.
2. Chiquete E, Ruiz-Sandoval JL, Murillo-Bonilla LM, Arauz A, Villarreal-Careaga J, León-Jiménez C, et al. Egresos por enfermedad vascular cerebral aguda en instituciones públicas del sector salud de México: un análisis de 5.3 millones de hospitalizaciones en 2010. *Rev Mex Neuroci*. 2012;13:252-8.
3. Asociación Mexicana de Enfermedad Vascular Cerebral. Estrategia DALE; 2022c. Available from: <https://amevasc.com.mx/pacientes/estrategia-dale>
4. Diaz R, Ruano M. Knowledge of symptoms and risk factors for stroke in an urban population in Colombia. *Acta Neurol Colomb*. 2011;27:195-204.
5. Falavigna A, Teles AR, Vedana VM, Kleber FD, Mosena G, Velho MC, et al. Awareness of stroke risk factors and warning signs in southern Brazil. *Arq Neuropsiquiatr*. 2009;67:1076-81.
6. Goldstein LB, Adams R, Becker K, Furberg CD, Gorelick PB, Hademenos G, et al. Primary prevention of ischemic stroke: a statement for healthcare professionals from the stroke council of the American heart association. *Circulation*. 2001;103:163-82.
7. Arauz A, Mendez B, Soriano-Navarro E, Ruiz-Franco A, Quinzanos J, Rodríguez-Barragán M, García-Valadez E, et al. Frequency of intravenous thrombolysis in Mexican patients with acute ischemic stroke. *Int J Stroke*. 2019;14:NP25.
8. Góngora-Rivera F. Perspective on stroke in Mexico. *Med Univ*. 2015;17:184-7.
9. Góngora-Rivera F, Gutiérrez-Jiménez E, Zenteno MA. Knowledge of ischemic stroke among a Mexico city population. *J Stroke Cerebrovasc Dis*. 2009;18:208-13.
10. Hawkes MA, Ameriso SF, Willey JZ. Stroke knowledge in Spanish-speaking populations. *Neuroepidemiology*. 2015;44:121-9.
11. Hurwitz AS, Brice JH, Overby BA, Evenson KR. Directed use of the Cincinnati prehospital stroke scale by laypersons. *Prehosp Emerg Care*. 2005;9:292-6.
12. Kim YS, Park SS, Bae HJ, Cho AH, Cho YJ, Han MK, et al. Stroke awareness decreases prehospital delay after acute ischemic stroke in Korea. *BMC Neurol*. 2011;11:2.
13. Muengtawepong S, Hungnok W, Hamrattaisai T. Poor recognition of prompted treatment seeking even with good knowledge of stroke warning signs contribute to delayed arrival of acute ischemic stroke patients in Thailand. *J Stroke Cerebrovasc Dis*. 2014;23:948-52.
14. Panício MI, Mateus L, Ricarte IF, de Figueiredo MM, Fukuda TG, Seixas JC, et al. The influence of patient's knowledge about stroke in Brazil: a cross sectional study. *Arq Neuropsiquiatr*. 2014;72:938-41.
15. Powers W. Acute Ischemic stroke. *N Engl J Med*. 2020;383:252-60.
16. Stroebel N, Müller-Riemenschneider F, Nolte CH, Müller-Nordhorn J, Bockelbrink A, Willich SN. Knowledge of risk factors, and warning signs of stroke: a systematic review from a gender perspective. *Int J Stroke*. 2011;6:60-6.
17. Teuschl Y, Brainin M. Stroke education: discrepancies among factors influencing prehospital delay and stroke knowledge. *Int J Stroke*. 2010;5:187-208.
18. Yang J, Zheng M, Chen S, Ou S, Zhang J, Wang N, et al. Knowledge of thrombolytic therapy for acute ischemic stroke among community residents in Western Urban China. *PLoS One*. 2014;9:e107892.