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Recognition of Stroke Warning Signs and Risk Factors Among Rural Population in Central Pennsylvania

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Abstract

Background—Recognition of stroke warning signs and risk factors reduces prehospital delay and increases stroke survival. The goal of this study was to evaluate the public knowledge of stroke warning signs and risk factors in a rural area in Central Pennsylvania.

Materials and Methods—In this study, the 2016 Sullivan County Health Fair attendees in central Pennsylvania answered a structured close-ended multiple choice questionnaire about stroke warning signs and risk factors. Further questions were asked about their reaction to acute stroke, the source of their stroke knowledge, and if they had personally known a stroke victim.

Results—Out of 163 respondents, 85.3% selected ≥3 (out of 4) correct stroke warning signs and 71.8% of respondents selected ≥3 (out of 5) correct stroke risk factors. Regarding the wrong stroke warning signs, 34.4% mentioned neck pain followed by chest pain (33.1%). Identification of ≥1 (out of 3) wrong stroke warning signs were significantly lower among the respondents of postgraduate level education in comparison with other literacy groups. 95.7% of respondents chose "call 911 immediately" in response to an acute stroke. A relative with a history of stroke was the most cited source of information. Multivariate analysis found that a high level of education increases odds of recognition of ≥3 correct stroke risk factors (0.21; 95% confidence interval, 0.09–0.61). Knowing anyone with stroke was associated with an awareness of the life-threatening nature of stroke ($r = 0.21$, $P < 0.01$).

Conclusion—Respondents' recognition of stroke warning signs was favorable. About 85% of respondents recognized at least three stroke warning signs with no significant age and literacy effect. Our results provide evidence that the subjects most at risk of stroke are those with the least awareness of stroke risk factors.

Keywords

Stroke; recognition; warning signs; risk factors; education

Introduction

Stroke is the most common cause of disability [1] and the fifth leading cause of death in the United States [2]. Every 40 seconds, someone suffers from a stroke in the United States, and every 4 min, someone dies of a stroke [3]. It has been estimated that increased life expectancy by 2020 will result in a higher incidence of stroke among population worldwide [4]. Urgent access to effective medical treatment, especially thrombolysis, is an important predictor of stroke outcome [5,6]. However, prehospital delay continues to be the main reason for treatment delay among stroke patients [7]. Different factors have been attributed to delays in treatment-seeking behavior among the victims of acute stroke; however, the main factor is thought to be the lack of public

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knowledge about stroke symptoms and the concept of "time is brain" [8,9]. Associations between higher knowledge of stroke among the patients, their family members, and timely treatment-seeking behavior have been described [10,11]. Therefore, increasing the public knowledge of stroke symptoms and risk factors may reduce prehospital delay, improve treatment-seeking behavior, and increase the chance of getting urgent medical attention [12].

Former stroke awareness studies have shown poor knowledge of stroke risk factors and warning signs among the general populations in different developing and developed countries [13–18]. Stroke knowledge surveys in the United States have shown different trends in public stroke knowledge in various time periods from significant improvement to no significant change, [17] with the more prominent incremental trend in stroke warning signs and knowledge [19].

The goal of this survey was to evaluate the public knowledge of stroke warning signs and risk factors in a rural area in Central Pennsylvania.

Methods

In this study, all local attendees of the 2016 Sullivan County Health Fair in Pennsylvania were selected to answer a questionnaire regarding stroke risk factors and warning signs. Sullivan County is an entirely rural community in Central Pennsylvania. It is the second least populous county in Pennsylvania with the total population of 6428 (male: 51.4%, white race: 95.9%) [20].

Our questionnaire was developed based on surveys formerly performed in the United States [14,21] and Europe [22,23]. Respondents who had received education for stroke warning signs and risk factors within the past three months of the survey were excluded from the study. A structured close-ended multiple choice questionnaire was administered. The questionnaire can be provided upon the request. The questionnaire included demographic queries as well as questions to assess the respondents' recognition of stroke risk factors and warning signs. Based on the Face, Arm, Speech, Time [24,25] stroke warning signs, the respondents chose the correct stroke warning signs among the following options: back pain, neck pain, droopy face, imbalance, arm weakness, speech difficulty, and chest pain. Subjects were also asked to select the correct stroke risk factors among the following: gender, stress, age factor, hypertension, diabetes, smoking, and hypercholesterolemia. Further questions asked about the subjects' reaction after observation of a person with acute stroke signs, the source of their stroke knowledge, if they were seeing a physician on a regular basis, if they believed stroke is preventable, and whether they personally knew a stroke victim. Each correct answer for stroke warning signs (droopy face, imbalance, arm weakness, and speech difficulty) and stroke risk factors (age factor, hypertension, diabetes, smoking, and hypercholesterolemia) received 1 point, and a composite score was calculated for every respondent. A similar scoring method was applied for wrong answers. Favorable scores of correct stroke warning signs or risk factors were equal to or more than 3, and a composite score of 1 or more for wrong stroke warning signs and risk factors represented wrong stroke knowledge.

After the questionnaire was completed, we educated the respondents regarding the signs and symptoms of stroke, critical nature of the disease, and the importance of calling 911. We also educated the respondents regarding the stroke risk factors and primary stroke prevention.

Statistical analysis

Normal and skewed distributed continuous variables are presented as mean ± standard deviation (SD) and median ± SD, respectively. Discrete values are demonstrated as median (Quartiles). The statistical difference among groups was detected using the χ^2-test, Fisher's exact test, unpaired *t*-test, and Mann–Whitney *U*-test as indicated for dichotomous or continuous variables. We used multivariable linear regression method to analyze the effects of gender, education, and age on stroke knowledge. A *p*-value of <0.05 was considered as statistically significant. Statistical package for the social sciences (SPSS, Chicago, IL, USA) version 17 for Windows was used for data analysis.

Results

A total of 163 respondents completed the survey. Only two respondents refused to complete the questionnaire. 73% of the study population were women, and 98.1% were white. Three cases did not answer the question of educational level. Table 1 includes the respondents' demographic information.

Subjects of the lowest literacy had the least awareness of the following stroke risk factors: hypertension (63.0%, $P = 0.009$) and diabetes (60.3%, $P = 0.006$). We did not observe any significant differences among different age groups in terms of identification of individual stroke warning signs and risk factors (Table 2); however, knowledge of ≥3 correct stroke risk factors was significantly higher among the postgraduate level literacy

Table 1. Baseline demographic information

Variable	Overall (*N* = 163)	<35 (*n* = 22)	35–49 (*n* = 20)	50–69 (*n* = 73)	≥70 (*n* = 48)
Sex					
Male (%)	44 (27.0)	5 (22.7)	3 (15.0)	18 (24.7)	18 (37.5)
Female (%)	119 (73.0)	17 (77.3)	17 (85.0)	55 (75.3)	30 (62.5)
Literacy					
High school (%)	72 (45.6)	9 (42.9)	10 (50.0)	29 (40.8)	24 (52.2)
Undergraduate (%)	43 (27.2)	4 (19.0)	6 (30.0)	23 (32.4)	10 (21.7)
Postgraduate (%)	43 (27.2)	8 (38.1)	4 (20.0)	19 (26.8)	12 (26.1)
Ethnicity					
White (%)	159 (98.1)	21 (95.5)	20 (100.0)	72 (98.6)	46 (97.9)
Black (%)	3 (1.9)	1 (4.5)	0 (0.0)	1 (1.4)	1 (2.1)

Table 2. Identification of correct and wrong stroke warning signs and risk factors (stratified by age)

Characteristics	Total (*N* = 163), *n* (%)	<35 (*n* = 22), *n* (%)	35–49 (*n* = 20), *n* (%)	50–69 (*n* = 73), *n* (%)	≥70 (*n* = 48), *n* (%)	*P*
Correct warning signs						
Speech difficulty (%)	151 (92.6)	20 (90.9)	19 (95.0)	67 (91.8)	45 (93.8)	**0.935**
Droopy face (%)	144 (88.3)	20 (90.9)	15 (75.0)	69 (94.5)	40 (83.3)	**0.058**
Arm weakness (%)	134 (82.2)	20 (90.9)	18 (90.0)	55 (75.3)	41 (85.4)	**0.198**
Imbalance (%)	126 (77.3)	21 (95.5)	15 (75.0)	54 (74.0)	36 (75.0)	**0.187**
Wrong warning signs						
Neck pain (%)	56 (34.4)	10 (45.5)	6 (30.0)	22 (30.1)	18 (37.5)	**0.541**
Chest pain (%)	54 (33.1)	11 (50.0)	8 (40.0)	16 (21.9)	19 (39.6)	**0.040***
Back pain (%)	27 (16.6)	6 (27.3)	4 (20.0)	8 (11.0)	9 (18.8)	**0.281**
Knowledge of correct warning signs ≥ 3 (%)	139 (85.3)	21 (95.5)	16 (80.0)	63 (86.3)	39 (81.3)	**0.401**
Wrong knowledge of warning signs 1 (%)	79 (48.5)	14 (63.6)	12 (60.0)	30 (41.1)	23 (47.9)	**0.196**
Correct risk factors						
Smoking (%)	128 (78.5)	18 (81.8)	18 (90.0)	60 (82.2)	32 (66.7)	**0.098**
Hypercholesterolemia (%)	123 (75.5)	18 (81.8)	16 (80.0)	56 (76.7)	33 (68.8)	**0.587**
Hypertension (%)	120 (73.6)	19 (86.4)	16 (80.0)	54 (74.0)	31 (64.6)	**0.233**
Diabetes (%)	118 (72.4)	19 (86.4)	16 (80.0)	53 (72.6)	30 (62.5)	**0.166**
Age factor (%)	102 (62.6)	18 (81.8)	11 (55.0)	51 (69.9)	22 (45.8)	**0.010***
Wrong risk factors						
Stress (%)	135 (82.8)	15 (68.2)	20 (100.0)	64 (87.7)	36 (75.0)	**0.013***
Gender (%)	73 (44.8)	13 (59.1)	11 (55.0)	33 (45.2)	16 (33.3)	**0.157**
Knowledge of correct risk factors ≥ 3 (%)	117 (71.8)	19 (86.4)	16 (80.0)	52 (71.2)	30 (62.5)	**0.170**
Knowledge of wrong risk factors ≥ 1 (%)	140 (85.9)	19 (95.5)	20 (100.0)	64 (87.7)	37 (77.1)	**0.088**

Table 3. Identification of correct and wrong stroke warning signs and risk factors (stratified by literacy level)

Characteristics	Total (*N* = 160), *n* (%)	High School (*n* = 73), *n* (%)	Undergraduate (*n* = 44), *n* (%)	Postgraduate (*n* = 43), *n* (%)	*P*
Correct warning signs					
Speech difficulty (%)	150 (93.8)	69 (94.5)	41 (93.2)	40 (93.0)	**0.934**
Droopy face (%)	141 (88.1)	62 (84.9)	40 (90.9)	39 (90.7)	**0.520**
Arm weakness (%)	132 (82.5)	63 (86.3)	35 (79.5)	34 (79.1)	**0.510**
Imbalance (%)	122 (76.3)	53 (72.6)	33 (75.0)	36 (83.7)	**0.387**
Wrong warning signs					
Neck pain (%)	56 (35.0)	31 (42.5)	17 (38.6)	8 (18.6)	**0.028***
Chest pain (%)	53 (33.1)	31 (42.5)	17 (38.6)	5 (11.6)	**0.002***
Back pain (%)	27 (16.9)	17 (23.3)	7 (15.9)	3 (7.0)	**0.075**
Knowledge of correct warning signs ≥ 3 (%)	136 (85.0)	63 (86.3)	36 (81.8)	37 (86.0)	**0.785**
Knowledge of wrong warning signs ≥ 1 (%)	78 (48.8)	44 (60.3)	24 (54.5)	10 (23.3)	**0.000***
Correct risk factors					
Hypertension (%)	118 (73.8)	46 (63.0)	34 (77.3)	38 (88.4)	**0.009***
Diabetes (%)	116 (72.5)	44 (60.3)	36 (81.8)	36 (83.7)	**0.006***
Smoking (%)	124 (77.5)	53 (72.6)	36 (81.8)	35 (81.4)	**0.397**
Hypercholesterolemia (%)	120 (75.0)	51 (69.9)	33 (75.0)	36 (83.7)	**0.250**
Age factor (%)	100 (62.5)	42 (57.5)	28 (63.6)	30 (69.8)	**0.415**
Wrong risk factors					
Gender (%)	71 (44.4)	30 (41.1)	19 (43.2)	22 (51.2)	**0.564**
Stress (%)	133 (83.1)	60 (82.2)	38 (86.4)	35 (81.4)	**0.792**
Knowledge of correct risk factors ≥ 3 (%)	114 (71.3)	44 (60.3)	34 (77.3)	36 (83.7)	**0.015***
Knowledge of wrong risk factors ≥ 1 (%)	137 (85.6)	61 (83.6)	40 (90.9)	36 (83.7)	**0.502**

group (83.7%, *P* = 0.015) compared to the rest of respondents (Table 3).

Out of 163 respondents, 34.4%, 33.1%, and 16.6% chose neck pain, chest pain, and back pain as the stroke warning signs, respectively (Table 2). Respondents from

Table 4. Source of stroke knowledge among respondents (stratified by age)

Source of stroke knowledge	Total (N = 163), n (%)	<35 (n = 22), n (%)	35–49 (n = 20), n (%)	50–69 (n = 73), n (%)	≥70 (n = 48), n (%)	P
Relative had a stroke	55 (33.7)	7 (31.8)	6 (30.0)	25 (34.2)	17 (35.4)	0.973
Media	52 (31.9)	7 (31.8)	7 (35.0)	27 (37.0)	11 (22.9)	0.433
Books and magazines	44 (27.0)	6 (27.3)	5 (25.0)	20 (27.4)	13 (27.1)	0.997
Friends	35 (21.5)	1 (4.5)	4 (20.0)	20 (27.4)	10 (20.8)	0.151
Doctor	33 (20.2)	3 (13.6)	4 (20.0)	14 (19.2)	12 (25.0)	0.725
Others	28 (17.2)	7 (31.8)	2 (10.0)	12 (16.4)	7 (14.6)	0.231
No stroke knowledge	11 (6.7)	3 (13.6)	1 (5.0)	4 (5.5)	3 (6.3)	0.580

Table 5. Source of stroke knowledge among the respondents (stratified by literacy level)

Source of stroke knowledge	Total (N = 160), n (%)	High school (n = 73), n (%)	Undergraduate (n = 44), n (%)	Postgraduate (n = 43), n (%)	P
Relative had a stroke	53 (33.1)	28 (38.4)	16 (36.4)	9 (20.9)	0.136
Media	51 (31.9)	26 (35.6)	13 (29.5)	12 (27.9)	0.640
Books and magazines	43 (26.9)	19 (26.0)	12 (27.3)	12 (27.9)	0.974
Friends	36 (22.5)	17 (23.3)	15 (34.1)	4 (9.3)	0.021*
Doctor	32 (20.0)	13 (17.8)	8 (18.2)	11 (25.6)	0.563
Others	27 (16.9)	11 (15.1)	8 (18.2)	8 (18.6)	0.854
No stroke knowledge	10 (6.3)	3 (4.1)	4 (9.1)	3 (7.0)	0.545

Table 6. Actions to be taken by respondents when a stroke occurs near them (stratified by age)

Action to be taken	Total (N = 163), n (%)	<35 (n = 22), n (%)	35–49 (n = 20), n (%)	50–69 (n = 73), n (%)	≥70 (n = 48), n (%)	P
Call 911 immediately	156 (95.7)	21 (95.5)	20 (100.0)	69 (94.5)	46 (95.8)	**0.765**
Drive the patient to an emergency room	21 (12.9)	5 (22.7)	2 (10.0)	10 (13.7)	4 (8.3)	**0.395**
Call a physician	8 (4.9)	0 (.0)	0 (.0)	7 (9.6)	1 (2.1)	**0.093**
Take the patient to a clinic	6 (3.7)	0 (.0)	0 (.0)	5 (6.8)	1 (2.1)	**0.260**
Wait only a few hours	2 (1.2)	0 (.0)	0 (.0)	1 (1.4)	1 (2.1)	**0.844**

Table 7. Actions to be taken by respondents when a stroke occurs near them (stratified by Literacy level)

Action to be taken	Total (N = 160), n (%)	High school (n = 73), n (%)	Undergraduate (n = 44), n (%)	Postgraduate (n = 43), n (%)	P
Call 911 immediately	152 (95.0)	69 (94.5)	43 (97.7)	40 (93.0)	0.583
Drive the patient to an emergency room	21 (13.1)	15 (20.5)	2 (4.5)	4 (9.3)	0.031*
Call a physician	7 (4.4)	4 (5.5)	1 (2.3)	2 (4.7)	0.710
Take the patient to a clinic	6 (3.8)	3 (4.1)	0 (.0)	3 (7.0)	0.225
Wait only a few hours	2 (1.3)	2 (2.7)	0 (.0)	0 (.0)	0.299

postgraduate literacy group had a significantly higher rate of not recognizing neck pain (18.6%, P = 0.028) and chest pain (11.6%, P = 0.002) as stroke signs (Table 3). Selecting ≥1 wrong stroke warning signs was significantly lower among the respondents of the postgraduate-level literacy in comparison with other literacy groups (23.3%, P < 0.001) (Table 3).

A relative with a history of stroke was the most cited source of information, followed by media, books, and magazines (Tables 4 and 5). Friends were chosen as the significantly least important source of stroke knowledge for postgraduate respondents compared to the subjects with high school and undergraduate literacy (9.3%, P = 0.021).

Most respondents' (95.7%) first measure in case of encountering a stroke patient was an immediate 911 call (Tables 6 and 7). 12.9% of the respondents reported that they would also consider "Drive the patient to an emergency room." There was a significant difference between respondents with high school or lower level education versus respondents who had an undergraduate or postgraduate education (20.5% vs. 6.8%, P = 0.031).

Table 8. Multivariable regression: factors related to knowledge of at least three stroke warning signs or risk factors

Factor	Odds ratio (95% confidence interval)	P-value
Knowledge ≥ 3 warning signs		
Age	–0.08 (–0.23–0.07)	0.308
Gender	0.04 (–0.24–0.42)	0.595
Education	0.03 (–0.14–0.21)	0.687
Knowledge ≥ 3 risk factors		
Age	–0.17 (–0.46—0.02)	0.037*
Gender	–0.03 (–0.57—0.41)	0.737
Education	0.21 (0.09–0.61)	0.008*

In the regression analysis, a higher level of education and younger age corresponded with better knowledge of stroke risk factors (Table 8). There was a correlation between the knowledge of stroke risk factors and knowing that stroke is preventable (r = 0.16, P < 0.05). Knowing anyone with stroke was related to familiarity with the life-threatening nature of the stroke (r = 0.21, P < 0.01) (Table 9).

Table 9. Correct and wrong stroke knowledge variables, regular physician visit variable, stroke preventability variable, stroke is life-threatening variable, know anyone with stroke variable, relative with stroke variable and calling of 911 variable correlations (*N*= 163), **P*< 0.05, ***P*< 0.01

Variables	1	2	3	4	5	6	7	8	9	10
Call 911	—									
Regular physician visit	–0.066	—								
Know anyone with stroke	0.051	0.017	—							
Relative with stroke	0.040	0.036	0.349**	—						
Stroke is preventable	0.014	–0.048	–0.026	–0.101	—					
Stroke is life-threatening	0.253**	0.042	0.205**	0.024	0.014	—				
Correct warning signs knowledge	0.219**	0.000	0.117	0.120	0.026	0.001	—			
Correct risk factors knowledge	0.032	–0.105	0.062	0.111	0.160*	0.062	0.193*	—		
Wrong warning signs knowledge	0.163*	–0.006	–0.090	0.060	–0.027	0.025	0.072	0.150	—	
Wrong risk factors knowledge	0.109	–0.095	0.074	0.113	0.021	-0.065	0.190*	0.291**	0.050	—

Discussion

Our stroke awareness survey assessed public recognition of stroke risk factors, warning signs, and some of the associated factors in a rural population in Central Pennsylvania. Respondents' recognition of stroke warning signs was favorable—about 85% recognized at least three stroke warning signs with no significant age and literacy effect. This exceeds the results of previous surveys [14,26–29]. The most frequently identified stroke warning signs were speech difficulty, droopy face, and arm weakness, similar to the results of previous studies [19,29,30]. Less than half of the studied population selected at least one or more wrong warning signs such as "neck pain" as the most common, followed by "chest pain" and "back pain." Selection of wrong stroke warning signs has been attributed to the confusion between signs of stroke and heart attack [29]. Although in our study, there were no statistically significant differences among different literacy groups regarding recognition of stroke warning signs, literacy level was found to play an important role in the identification of the wrong warning signs. More than half of respondents with high school level of education chose at least one or more wrong warning signs, while this was less than one-third of the respondents with postgraduate literacy level.

In contrast to previous studies [9,31], our subjects had lower awareness of stroke risk factors compared to stroke warning signs. Nevertheless, our subjects had better stroke risk factor awareness in comparison with other surveys [14,19,21]. The most frequently selected risk factor was smoking, followed by hypercholesterolemia, hypertension, diabetes, and age factor. Nearly 60% of our respondents with high school education identified hypertension and diabetes as stroke risk factors. It was significantly lower than subjects with higher education but much more than former studies [29,31]. Furthermore, the higher rate of selection wrong stroke risk factors, compared to the correct ones, shows a sensible gap of risk factor knowledge compared to warning signs knowledge among respondents in our cohort.

In previous studies [9,31,32], in the case of stroke suspicion, respondents selected "immediate 911 call" between 27% and 100%. Our result is closer to the higher end of this range. In a former survey [33], older age had a negative effect on the likelihood of calling 911. The proportion of respondents who called 911 were reported to be different based on each stroke warning sign [34].

Previous surveys cited different major sources of stroke information among their respondents [14,15,18]. Source of stroke knowledge included a relative with stroke history, media, books/magazines, doctor, and other sources in our cohort. Pancioli *et al.* [14] reported "relative with a history of stroke" as the main source of stroke information. 20.2% of our respondents selected physician as their source of knowledge. It seems such a wide range of results for stroke source of information in various studies may be related to personal preference or remembrance at the time of interview. Nevertheless, the respondents may achieve stroke knowledge over time from multiple sources.

The proportion of our respondents who correctly recognized at least three warning signs and risk factors were significantly higher compared to former studies [31,34] and this may be attributed to the type of questions used. It might be easier to recognize the stroke signs and risk factors when the questions are multiple choice [34,35]. Rowe *et al.* [36] compared the results of correctly identified stroke risk factors using both close-ended and open-ended questions. The correct answers for close-ended questions were between 77% and 95% while this range was between 7% and 24% for open-ended questions.

We found that younger age and a high level of education is significantly associated with a higher rate of identifying stroke risk factors. Our results provide some evidence that in our population the subjects most at risk of stroke are the group with the least knowledge of stroke risk factors.

We should interpret high levels of stroke knowledge cautiously. In real, stressful situations, people's behaviors are influenced by various emotional, psychological, and regional factors. Therefore, having a higher score in the stroke knowledge survey will not guarantee respondents' proper action in critical moments [37].

A small sample size was one of the limitations of this study. However, we had a higher response rate compared to other similar studies with less than 200 respondents [38,39]. We also used convenience sampling which can be subject to sampling bias. Although we excluded subjects who had received information about stroke signs and risk factors, attendants of health fair may have more basic awareness of stroke compared to the rest of the population.

Our findings support regular public stroke education with more emphasis on subjects with lower literacy and elderlies. Stroke training programs should be tailored based on the target populations. Further studies are needed to define associated factors for a long-lasting behavior change among individuals with stroke risk factors.

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