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The International Stroke Survey: a multicountry perspective of public knowledge of cerebral stroke

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ABSTRACT

Background: As acute stroke remains an important leading cause of morbidity and mortality in the world, this study sought to survey the general public in four different countries, on four different continents to ascertain the level of knowledge of the public for the risk factors (RFs), and the signs and symptoms (S&S) of stroke.

Methods: This was a cross-sectional survey of the general public that was conducted via a self-administered online survey using the SurveyMonkey® platform in the United States, the United Kingdom, the Kingdom of Saudi Arabia, and Egypt. Questions on identifying the RFs, as well as the S&S of stroke were asked. A score was given to all subjects, and they were then asked to identify the lifestyle changes that they thought would reduce the risk of getting a stroke.

Results: A total of 2,000 subjects were recruited via the electronic search engine at the SurveyMonkey®, 500 from each country. The data showed that subjects in Western countries agreed that dyslipidemia and lack of exercise were the top two RFs for stroke. While the Middle Eastern subjects mostly identified smoking and having a previous stroke as the top RFs. Regarding the S&S, Western subjects agreed perfectly that the top three were hemiparesis, heavy tongue, and facial asymmetry.

Conclusion: It was clear from the data collected in this study that the knowledge level of S&S of stroke in the general public, irrespective of the country was poor.

Keywords: Stroke, public, risk factors, signs and symptoms, lifestyle.

Introduction

Stroke remains, to this day, one of the leading major causes of morbidity in the world. Trailing in third place [1], after coronary heart disease and major trauma, it is one of the major causes of disability around the world. Similar to acute coronary syndrome, and major trauma, stroke is associated with a time-benefit window, where earlier treatment is believed to be more beneficial than delayed treatment. And although a debate that has been going on for the better part of the last 25 years, concerning the beneficial effects of thrombolytics in acute ischemic stroke, a decisive conclusion has yet to be reached [2–4]. Interventional thrombectomy, on the other hand, represented a totally different picture. Multiple studies have shown, with little to no doubt, that mechanical thrombectomy is beneficial, and that the time to implementation of management is still the most important factor that determines how beneficial the outcome is [5–11].

As such, the time from symptom onset to presentation at a healthcare facility is the key to achieving the best outcomes possible. Previously it was shown, in a number of studies, that emergency medical services (EMSs) response was not a major contributing factor to management delay in stroke. As such, the remaining parameter that can affect the time in which stroke patients receive their management is the recognition of the signs and symptoms (S&S) of the disease and subsequent activation of the EMS.

Previously, a multistate study using data from the Behavioral Risk Factor Surveillance System (BRFSS) surveyed the public in the US about their knowledge of the S&S of stroke. Although there were a lot of variations

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between different states, the BRFSS data showed the public to be highly aware of facial or body weakness (94%) and sudden onset of severe headaches (61.3%) [12,13]. Further to that, 85% of participants said that they would activate the EMS by calling the 911 emergency service line in such circumstances [13].

Hence, this survey was conducted to assess the S&S of stroke across four different countries. Two Western countries (WCs) including the United States, and the United Kingdom, and two Middle Eastern countries (MECs) including the Kingdom of Saudi Arabia, and Egypt. It was hypothesized that the WCs should be similar in findings to the previously published BRFSS data, as they share a similar language base, cultural and social norms, as well as religious background and history. Regarding the MECs, it was determined that they too share a history, a language, and similar cultural and social structural norms. As such, the survey was set out to look at how the MECs populations measure up against the WCs, as well as against each other concerning the public knowledge of the S&S of stroke, its risk factors (RFs), preventive lifestyle changes, and the source of that knowledge.

Subjects and Methods

This was a cross-sectional study that was conducted among the general public in four countries over a period of 3 months. Two of them were WCs and the other two were countries in the Middle East including the United States of America (USA), the United Kingdom (UK), the Kingdom of Saudi Arabia (KSA), and Egypt.

Data were collected by way of a self-administered online questionnaire composed of 30 items. Information was collected about the subject demographics (age, gender, and educational level of each subject were obtained, and the country they were residing in), knowledge about stroke RFs, S&S, and methods of lifestyle changes that would be effective in the reduction of the risk of having a stroke was obtained. Information on how confident the subject was with the given answers and the source from which the information was obtained was also collected. The surveys were translated from English to Arabic and back to English to confirm language equivalency.

All questions in the survey were adapted from the advanced cardiac life support (ACLS) and basic life support (BLS) course books and thus have been validated.

Subjects were assessed on their knowledge of stroke RFs through the identification of important RFs that would lead a person to have an increased risk of getting a stroke. From a collection of 15 different items, the subject was given 1 point for every correctly identified RF, and 0 points if a wrong RF was identified or missed a correct one.

Furthermore, subjects were assessed on their recognition of the S&S of stroke. The subjects were asked to identify all the S&S that clinically should be present in a patient with acute stroke from a collection of 15 different S&S. Each subject was given 1 point for every correctly identified S&S, and 0 points if a wrong S&S was identified or missed a correct one.

Moreover, subjects were also asked about their action if a person would have an acute stroke in front of them. They were allowed to choose from the following options including calling 9-1-1, taking the patient to the closest clinic, taking the patient to a general versus specialized hospital, or choosing the option "I don't know." Obviously, this question did not have a correct or incorrect answer, as medical systems in each country are different, hence only the answer proportions were calculated using this data.

In addition, subjects were asked to identify the top three lifestyle changes that would be best to lower the risk of getting a stroke. Changes such as controlling one's blood pressure, eating healthier, losing weight, stopping smoking or drinking alcohol, and so on. Again, only proportions were calculated from this data as each item was a risk-reducing strategy of some benefit.

Finally, the subjects were asked for any previous cardiopulmonary resuscitation (CPR) training. As all these items are mentioned in the American Heart Association BLS and ACLS training courses, a CPR provider hence should know the answers to the questions being asked. All subjects were asked to rank their confidence in the answers they gave and to tell the source of the provided information, such as friends and family, social media outlets, medical sites, physicians, and so on.

It was also intended to conduct a subgroup analysis (SGA) to ascertain the difference in the answers given by the subjects depending on the country they were from, their age, gender, education level, the source of their information, or their previous CPR training.

For a confidence interval of 95%, and a margin of error of 5% in a general population in excess of 20,000. The required sample size was found to be 385 as calculated by an online calculator Qualtrics (https://www.qualtrics.com/blog/calculating-sample-size/). Since, the survey was conducted in four different countries, a sample of at least 1,540 was required. Factoring in 10% would not fill in the entire survey, a total of 500 surveys per country were conducted for a total of 2,000 subjects overall. The survey was conducted using the SurveyMonkey® engine (http://www.surveymonkey.com). The data collecting engine was instructed to obtain data from 500 subjects from the general population via email in the USA, UK, KSA, and Egypt.

Once the data were collected it was input into a single database and analyzed using the Statistical Packages for Software Sciences v.26. The Mann-Whitney *Z*-test and Kruskal Wallis *H*-test measured the sociodemographic data, RFs, and the data on S&S. Due to the non-normal distribution of data, the nonparametric Pearson correlation test was applied for all subgroup analyses to ascertain the statistical significance of the findings.

Results

A total of 2,000 subjects from four countries were surveyed. Subjects in the US and UK mostly agree on

dyslipidemia and lack of exercise being RFs for stroke in the WCs. While in the MECs, smoking and previously sustaining a cerebrovascular accident (CVA) were considered to be the most common RFs identified by subjects. In all countries, subjects agree that ethnicity is NOT an RF (although it has been shown in multiple studies that patients of certain ethnic backgrounds do have a greater risk of having a stroke, simply because they are at greater risk of having the RFs for stroke, such as diabetes and hypertension, and so on). Furthermore, regarding the identification of the S&S of stroke, subjects in the WCs agreed that hemiparesis, heavy tongue (dysarthria), and facial weakness/numbness were the most common symptoms. In contrast, subjects in the MECs reported a loss of consciousness to be the number one S&S of stroke. Interestingly, hemiparesis did not make the top three most common S&S reported by subjects (even though one might argue that the hallmark presentation of stroke is paralysis of half of the body with weakness on one side) (Table 1).

Out of the 15 items listed as RFs for stroke, only 12 were actually true RFs. Furthermore, out of the 15 items listed as S&Ss for stroke, only 11 were actually true S&Ss. A score of 1 point was given to each correct answer, and hence a score for subjects in each country was calculated. The red line was placed at the 50% mark. The mean scores for each country and the SD were calculated. Scoring <50% showed a poor understanding of the knowledge that the public has about acute stroke. A score of 50%-75% showed a moderate level of knowledge

Table 1. *Data of demographics, RFs, S&S of stroke.*

Parameter	Finding	USA	UK	*p*-value	KSA	Egypt	*p*-value	WC	MEC	*p*-value
Age	<35 years	220	191	0.062	389	373	0.234	411	762	<0.000**
	>35 years	280	309		111	127		589	238	
Gender	Male	166	265	<0.000**	305	437	<0.000**	431	742	<0.000**
	Female	334	235		195	63		569	258	
Education	Beyond high school	244	339	<0.000**	244	367	<0.000**	583	611	0.201
	Up to high school	256	161		256	133		417	389	
RF for stroke	Smoking	290	296	0.700	108	206	<0.000**	586	314	<0.000**
	All others	210	204		392	294		414	686	
	KD	76	52	0.023**	76	52	0.023**	128	128	1
	Others	424	448		424	448		872	872	
	AF	156	131	0.080	58	89	0.005**	287	147	<0.000**
	All others	344	369		442	411		713	853	
	HTN	292	260	0.041**	98	258	<0.000**	552	356	<0.000**
	All others	208	240		402	242		448	644	
	Alcohol/drugs	233	231	0.899	117	122	0.710	464	239	<0.000**
	All others	267	269		383	378		536	761	
	CAD	281	239	0.007**	76	171	<0.000**	520	247	<0.000**
	All others	219	261		424	329		480	753	
	DM	197	160	0.014**	69	89	0.082	357	158	<0.000**
	All others	303	340		431	411		643	842	
	Lack of exercise	297	292	0.747	83	161	<0.000**	589	244	<0.000**
	All others	203	208		417	339		411	756	
	Previous CNS infection	99	77	0.067	42	34	0.339	176	76	<0.000**
	All others	401	423		458	466		824	924	
	Dyslipidemia	300	292	0.606	87	193	<0.000**	592	280	<0.000**
	All others	200	208		413	307		408	720	
	Previous stroke	294	280	0.370	127	200	<0.000**	574	327	<0.000**
	All others	206	220		373	300		426	673	
	Mood disorder	64	37	0.004**	76	173	<0.000**	101	249	<0.000**
	All others	436	463		424	327		899	751	
	CVA in first degree relative	195	154	0.006**	35	41	0.474	349	76	<0.000**
	All others	305	346		465	459		651	924	
	Advanced age	172	158	0.346	83	152	<0.000**	330	235	<0.000**
	All others	328	342		417	348		670	765	
	Ethnicity	47	18	0.000**	25	5	0.000**	65	30	0.000**
	All others	453	482		475	495		935	970	

Continued

Parameter	Finding	USA	UK	*p*-value	KSA	Egypt	*p*-value	WC	MEC	*p*-value
S&S of stroke	Hemiparesis	359	335	0.099	78	102	0.048**	694	180	<0.000**
	All others	141	165		422	398		306	820	
	Dizziness	216	133	<0.000**	96	195	<0.000**	349	291	0.005**
	Others	284	367		404	305		651	709	
	Loss of consciousness	193	136	0.000**	141	265	<0.000**	329	406	0.000**
	All Others	307	364		359	235		671	594	
	Dysphagia	247	214	0.036**	55	77	0.039**	461	132	<0.000**
	All Others	253	286		445	423		539	868	
	Facial Palsy	266	290	0.126	67	117	<0.000**	556	184	<0.000**
	All others	234	210		433	383		444	816	
	Limb pain	135	86	0.000**	77	106	0.017**	221	183	0.034**
	All others	365	414		423	394		779	817	
	Heavy tongue	309	314	0.744	126	262	<0.000**	623	388	<0.000**
	All others	191	186		374	238		377	612	
	Headache	172	135	0.011**	102	156	<0.000**	307	258	0.014**
	All others	328	365		398	344		693	742	
	Numbness	347	320	0.070	85	132	0.000**	667	217	<0.000**
	All others	153	180		415	368		333	783	
	Seizure	146	102	0.001**	98	136	0.004**	248	234	0.464
	All others	354	398		402	364		752	766	
	Nausea and vomiting	116	68	<0.000**	45	38	0.422	184	83	<0.000**
	All others	384	432		455	462		816	917	
	Diplopia	176	109	<0.000**	45	68	0.021**	285	113	<0.000**
	All others	324	391		455	432		715	887	
	Ataxia	274	213	0.000**	103	181	<0.000**	487	284	<0.000**
	All others	226	287		397	319		513	716	
	Fever	45	32	0.123	61	54	0.487	77	115	0.003**
	All others	455	468		439	446		923	885	
	Tinnitus	93	69	0.039**	51	57	0.541	162	108	0.000**
	All others	407	431		449	443		838	892	

USA = United States of America; UK = United Kingdom; KSA = Kingdom of Saudi Arabia; WC = Western countries; MEC = Middle Eastern countries; RF = risk factor; S&S = sign and symptom; KD = kidney disease, AF = atrial fibrillation; HTN = hypertension; CAD = coronary artery disease; DM = diabetes mellitus; CNS = central nervous system.
**Statistically significant p-value <0.05.

while scoring above 75% was considered as a good level of knowledge. It was found that subjects in WCs mostly had moderate knowledge of the RFs and the S&Ss of stroke. In the MECs, knowledge was mostly poor across the board, with subjects in Egypt doing a little better than those in Saudi Arabia (Figures 1 and 2).

When subjects were asked what they would do if they were presented with a patient having a stroke, answers from subjects in WCs were overwhelmingly (>85%) in favor of calling 9-1-1 and the EMS. While responses in the MECs were split between calling 9-1-1, and personally taking the patient to the closest general hospital. As for lifestyle changes that would protect against (reduce the risk of) getting a stroke, there was almost a consensus. The number one chosen lifestyle change that everyone in this survey agreed upon in all countries, from west to east, and was thought to be beneficial was the cessation of smoking. This was closely followed in second place by adopting physical exercise, as a way of reducing the risk of stroke. With regards to the sources of information used by subjects to answer the questions in this survey, subjects in WCs mostly got their information from family and friends, as well as television and movies they have seen. In the MECs, family and friends, seem to be the main source of information for most subjects; however, in second place, subjects reported getting information from medical journals (Table 2).

As far as confidence in the answers being given to the survey questions, in WCs at least 50% of all subjects were confident in their answers and about 37% were not sure, leaving only 13% not confident in what was reported. In the MECs, however, subjects were split almost into thirds. One third of the subjects were confident, one third were unsure, and the last third were not confident (Table 3).

Discussion

The main objective of this study was to ascertain the level of knowledge of stroke RFs, and the S&S of stroke across population samples from four very different countries on four different continents. The final analysis concluded that the populous in the West were a little bit

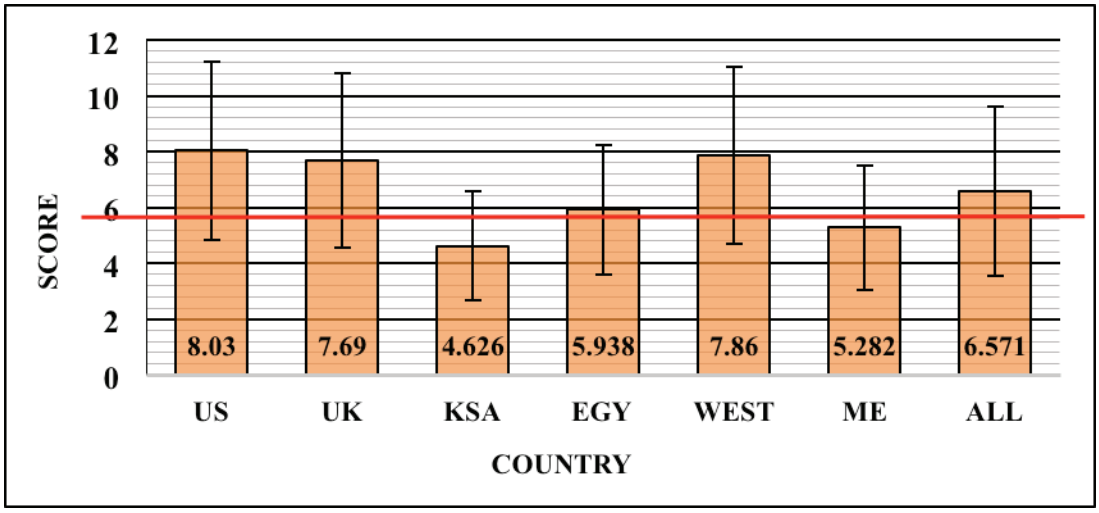

Figure 1. *RF knowledge score of the countries. US = United States of America; UK = United Kingdom; KSA = Kingdom of Saudi Arabia; EGY = Egypt; WEST = Western countries; ME = Middle Eastern countries.*

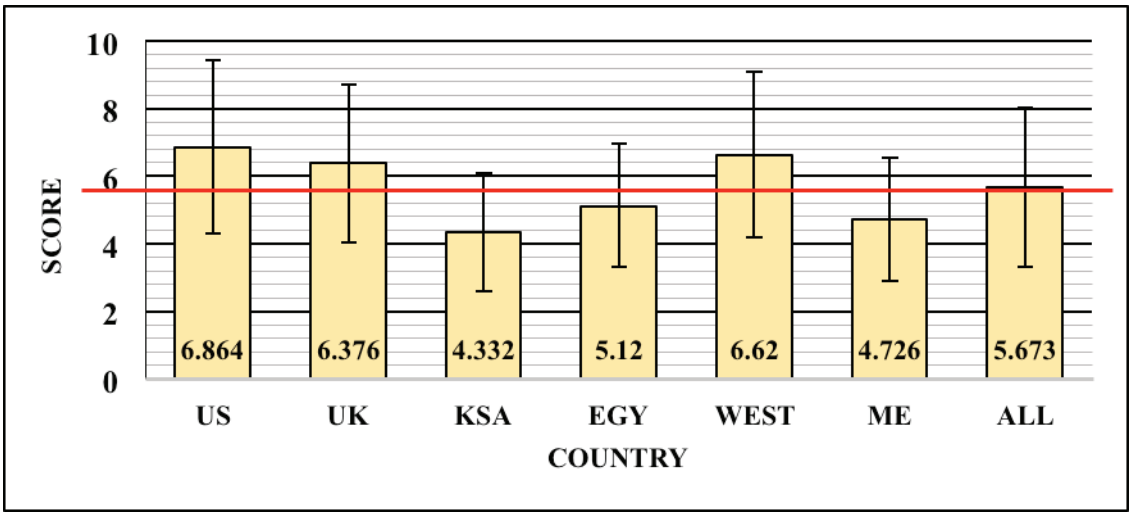

Figure 2. *Sign and symptom knowledge score of the countries. US = United States of America; UK = United Kingdom; KSA = Kingdom of Saudi Arabia; EGY = Egypt; WEST = Western countries; ME = Middle Eastern countries.*

more knowledgeable about the RFs and the S&Ss of stroke than their counterparts in MECs.

To start with, subjects recruited from the US were predominantly female. While those from Saudi Arabia and Egypt were 3:1 male. Overall, the sample showed a 60%-40% split of males to females. Further to that, almost 20% of all subjects in the WCs were above the age of 54 years. This could have been a source of bias, as older subjects should have more knowledge than younger ones, simply as they had more experiences in their lifetime. This difference in the age distribution was also seen and mirrored in the education level, as high educational levels were seen more in the WCs relative to the MECs.

With regards to the public knowledge of the RFs of stroke, the overall knowledge of the public was poor. WCs were better than the MECs, but only with a very narrow margin. Further SGA observed the effect of CPR training, it was noted that the WCs had more subjects who had had previous CPR training than those in MECs. Where, it was 40%-50% of the subjects in WCs were trained, while in MECs the percentage was close to 20%-30%. Overall, subjects who had CPR training scored higher than those who did not have training. Furthermore, 46.6% of CPR-trained individuals identified more than 50% of stroke RFs versus only 32.0% without CPR training (p-value <0.0001). Therefore, it would stand to reason that since the subjects recruited in the WCs were more likely to be CPR trained than their MECs counterparts, this could explain the difference in the RF scores between the WCs subjects and the MECs subjects. Similarly, this effect was seen more profoundly when the sign and symptom data was assessed. Where 32.2% CPR trained subjects identified more than 50% stroke RFs versus only 16.3% of those without CPR training (p-value <0.0001).

It was interesting to see that subjects in the WCs agreed on obesity (dyslipidemia) and lack of exercise as being two of the top RFs for stroke, while subjects in the MECs were mainly concerned with smoking being the top

Table 2. *CPR training, source of information, and lifestyle changes that reduce the risk of stroke.*

Parameter	Finding	USA	UK	*p*-value	KSA	Egypt	*p*-value	WC	MEC	*p*-value
CPR training	CPR trained	237	198	0.012**	150	107	0.001**	435	257	<0.000**
	Not trained	263	302		350	393		565	743	
Action when a stroke patient is identified	Call 911	424	442	0.0947	184	194	0.5143	866	378	<0.000**
	All others	76	58		316	306		134	622	
	Take to closest clinic	13	11	0.679	45	30	0.0717	24	75	<0.000**
	Others	487	489		455	470		976	925	
	Take to closest GH	41	27	0.0786	130	171	0.0047**	68	301	<0.000**
	All others	459	473		370	329		932	699	
	Take to closest SH	8	6	0.5904	60	92	0.0048**	14	152	<0.000**
	All others	492	494		440	408		986	848	
	Do not know what to do	13	14	0.845	81	13	<0.000**	27	94	<0.000**
	All others	487	486		419	487		973	906	
Lifestyle change to reduce the risk of stroke	Eat healthy diet	330	291	0.011**	170	207	0.015**	621	377	<0.000**
	All others	170	209		330	293		379	623	
	Control DM	51	45	0.519	156	100	<0.000**	96	256	<0.000**
	All others	449	455		344	400		904	744	
	Exercise	271	271	1	270	347	<0.000**	542	617	<0.000**
	All others	229	229		230	153		458	383	
	Control BP	220	186	0.028**	204	221	0.276	406	425	0.388
	All others	280	314		296	279		594	575	
	Stop smoking	348	367	0.1832	237	338	<0.000**	715	575	<0.000**
	All others	152	133		263	162		285	425	
	Stop abusing Alcohol/drugs	89	140	0.000**	236	170	<0.000**	229	406	<0.000**
	All others	411	360		264	330		771	594	
Source of information used in the answers given in this survey	Friends and family	216	146	<0.000**	151	165	0.341	362	316	0.029**
	All others	284	354		349	335		638	684	
	TV and movies	169	234	<0.000**	51	85	0.001**	403	136	<0.000**
	All others	331	266		449	415		597	864	
	Newspapers/ magazines	119	120	0.940	78	117	0.001**	239	195	0.017**
	All others	381	380		422	383		761	805	
	Social media/GIS	121	85	0.004**	55	165	<0.000**	206	220	0.444
	All others	379	415		445	335		794	780	
	Medical internet sites	137	90	0.000**	64	105	0.000**	227	169	0.001**
	Others	363	410		436	395		773	831	
	Medical journals	164	106	<0.000**	110	149	0.004**	270	259	0.577
	All others	336	394		390	351		730	741	
	Physicians	163	66	<0.000**	81	113	0.010**	229	194	0.055
	All others	337	434		419	387		771	806	
	HS and Univ. Education	112	85	0.031**	113	104	0.489	197	217	0.269
	All others	388	415		387	396		803	783	

USA = United States of America; UK = United Kingdom; KSA = Kingdom of Saudi Arabia; WC = Western countries; MEC = Middle Eastern countries; GH = general hospital; SH = specialized hospital; DM = diabetes mellitus; BP = blood pressure; GIS = general internet sites; HS = high school; Univ. = University.
**Statistically significant p-value <0.05

RF. Such difference is understandable since 11.5% and 13.3% of the general public in the US and UK smoke, respectively, while in Egypt and the Kingdom of Saudi Arabia, 16.8% and 19.8% of the general public smoke, respectively [14–17].

Regarding the S&S of stroke, WC subjects agreed that hemiparesis and facial asymmetry were the top two symptoms of stroke, while having a heavy tongue (slurred speech) came in third place. Subjects in the MECs identified loss of consciousness, and a heavy tongue as being the most commonly identified symptoms

Table 3. *SGA data.*

Score	Country	Age <35 years	Age >35 years	Male	Female	Higher than HS	HS or below	CPR trained	Not trained
Identified more than 50% of RFs of stroke	US	46.4%	63.6%	54.8%	56.6%	62.7%	49.6%	70.0%	57.4%
	p-value	0.0001**	0.7077	0.0032**	0.0034**				
	UK	42.9%	57.9%	47.5%	57.4%	56.0%	44.1%	55.6%	50.0%
	p-value	0.0011**	0.0270**	0.0125**	0.2239				
	KSA	8.7%	7.2%	8.9%	7.7%	10.2%	6.6%	5.3%	9.7%
	p-value	0.6075	0.6483	0.1463	0.1056				
	Egypt	23.1%	26.8%	23.1%	30.2%	25.1%	21.1%	34.6%	21.1%
	p-value	0.3971	0.2208	0.3529	0.0038**				
	WC	44.8%	60.6%	50.3%	56.9%	58.8%	47.5%	63.4%	53.5%
	p-value	<0.0001**	0.0382**	0.0004**	0.0015**				
	MEC	15.7%	17.6%	17.3%	13.2%	19.1%	11.6%	17.5%	15.7%
	p-value	0.4876	0.1262	0.0015**	0.5085				
	Over all	25.9%	48.2%	29.4%	43.3%	38.5%	30.1%	46.4%	32.0%
	p-value	<0.0001**	<0.0001**	0.0001**	<0.0001**				
Identified more than 50% of S&S of stroke	US	50.0%	57.1%	49.4%	56.3%	59.0%	49.2%	47.7%	31.9%
	p-value	0.1117	0.1455	0.0280**	0.0003**				
	UK	40.8%	46.9%	42.3%	47.2%	47.2%	39.1%	35.4%	26.2%
	p-value	0.1833	0.2645	0.0900	0.0279**				
	KSA	10.3%	8.1%	9.8%	9.7%	11.9%	7.8%	5.3%	4.9%
	p-value	0.4967	0.9729	0.1257	0.8229				
	Egypt	21.7%	17.3%	20.8%	19.0%	21.8%	17.3%	16.8%	8.4%
	p-value	0.2904	0.7445	0.2711	0.0107**				
	WC	45.7%	51.8%	45.0%	52.5%	52.1%	45.3%	42.1%	28.8%
	p-value	0.0601	0.0182**	0.0334**	<0.0001**				
	MEC	15.9%	13.0%	16.3%	12.0%	17.8%	11.1%	10.1%	6.7%
	p-value	0.2844	0.0981	0.0036**	0.0773				
	Over all	26.3%	40.6%	26.9%	39.9%	34.6%	28.8%	30.2%	16.3%
	p-value	<0.0001**	<0.0001**	0.0064**	<0.0001**				

US = United States of America; UK = United Kingdom; KSA = Kingdom of Saudi Arabia; WC = Western countries; MEC = Middle Eastern countries; HS = high school.
**Statistically significant *p*-value <0.05.

of stroke. Interestingly, hemiparesis, which is a hallmark of stroke, was chosen in tenth place. Symptoms such as seizures, headache, and ataxia were identified to be more common as symptoms of stroke, than hemiparesis. The overall scores of identifications of the S&S of stroke were a little worse than those of the RF scores.

As far as the choices of actions that subjects would take, if they identified a stroke patient, were influenced by the medical systems that are in place in each country. Hence, it was seen that in the WCs, the number one action; once a person identifies a stroke patient is to call 9-1-1 EMS. Such an action was not seen in the MECs where the EMS services are not as developed or robust as in the West, where calling 9-1-1 is twice as popular in WCs (69.6% *vs.* 30.4%, respectively, *p*-value <0.0001). Other reasons that also explain this difference were shown in previous studies to be the ignorance of the majority of the public in MECs of the number with which to call the EMS services, and the long transit time needed for the EMS to reach the caller [18]. Subjects in the MECs chose to take the patient to a general hospital rather than a specialized hospital, which is most likely due to a larger number of general hospitals versus specialized hospitals. Again, such answers could be based on such causes as the region that the subject is living in (rural versus urban), the catchment areas of the healthcare facilities in that region, and the demographics of the population that that healthcare facility sees (e.g., military versus general public).

Looking at the choices made by the subjects surveyed on lifestyle changes that they thought were most beneficial in reducing the risk of stroke, a nice consistency in the results was observed. Subjects from the US, for example, identified dyslipidemia, and lack of exercise as RFs for stroke, most went on to choose lifestyle changes that would neutralize these RFs. Understandably, two of the top choices made by US subjects were to eat a healthy diet, which should nullify the dyslipidemia as a RF. And exercise more, which would resolve the lack of exercise

as a RF. Similarly, in other countries, smoking was identified as a RF and then stop smoking was chosen as a lifestyle change that would reduce the risk of stroke. When looking at data superficially, everything would seem to fit logically with the way of thinking. However, upon further evaluation of the data, a different pattern emerges. It is very clear that only half of the subjects that identified diabetes as an RF also identified the control of diabetes as a lifestyle change that would be protective against stroke. As with exercise and the control of blood pressure, many more chose that as a lifestyle change than having identified it as an RF for stroke.

Upon SGA it was found that the WCs older people identified more RFs of stroke than their younger counterparts. Almost 20% of subjects in the older age brackets identified more than 50% of the RFs than the younger subjects in the US and UK with a *p*-value <0.0001. Similarly, education level seemed to have an effect as well. The higher the educational level of a subject, the more likely that subject would score higher (by about 10% higher *p*-value = 0.0125) in the identification of stroke RFs. As age and educational level are related to each other in an association, rather than a causation relation, it could not be analyzed which is more responsible for the differences seen.

However, the survey had some limitations. Unequal distribution of the age of subjects between countries might or might not be a source of bias. Since older subjects had more experiences and a longer life span to have learned or seen strokes. This also reflected the education level differences. Furthermore, this survey was conducted using the SurveyMonkey® engine. The data collecting engine was instructed to obtain data from 500 subjects from the general population via email in the USA, UK, KSA, and Egypt. As such, any and all potential subjects of the population in any country that did not have access to email, or the internet were thus excluded from being recruited for this survey.

Conclusion

The level of knowledge of the public regarding the RFs and the S&S of stroke was poor for the most part irrespective of the country being surveyed, only rising to moderate levels in the western countries, and even then, only by a small margin. Such findings are consistent with previous studies looking at the same topic. In general, people belonging to an older age bracket, and those who had CPR training tend to have more knowledge about stroke RFs, as well as S&S.

List of Abbreviations

ACLS	Advanced cardiac life support
BLS	Basic life support
BRFSS	Behavioral Risk Factor Surveillance System
CPR	Cardiopulmonary resuscitation
CVA	Cerebrovascular accident
EMS	Emergency medical services
KSA	Kingdom of Saudi Arabia
MEC	Middle Eastern countries
RFs	Risk factors
SGA	Subgroup analysis
S&S	Signs and symptoms
UK	United Kingdom
USA	United States of America
WC	Western countries

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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Consent to participate

Informed consent was obtained from the participants.

Ethical approval

Approval for this study was provided by the Research Committee at King Fahad Armed Forces Hospital, Jeddah, Reference: REC 634 on November 2023.

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