**INTERNATIONAL JOURNAL OF BIOMEDICINE**

ORIGINAL ARTICLE

Medical Education

# Knowledge, Attitude, and Practice of Stroke and Its Risk Factors and Warning Signals Among the Students of the College of Applied Medicine at Majmaah University, Saudi Arabia

Moattar Raza Rizvi[1], *Nagi Ibrahim Ali[2], Alaa Ibrahim Ahmed[2],
Rahma Abdalla Adam[2], Sami N. A. Elgak

*[1]Department of Physiotherapy, Faculty of Allied Health Sciences, Manav Rachna International Institute of Research and Studies (MRIIRS), Faridabad, India*
*[2]Department of Radiological Sciences and Medical Imaging, College of Applied Medical Sciences, Majmaah University, Majmaah 11952, KSA*

## Abstract

***Background***: Knowledge, attitude, and practice (KAP) connected to stroke risk factors, treatment, and the outcome may aid in early case diagnosis, prevention, and minimization of stroke-associated consequences through prompt hospitalization. The goal of our study was to identify the KAP of strokes and explore the relationship between KAP and stroke among Majmaah University students.

***Methods and Results***: Knowledge, attitude, and practice (KAP) of strokes, their risk factors, and warning signs were assessed among Majmaah University students using a convenience sampling method. The study was conducted using a self-administered questionnaire that had been pre-validated. A total of 284 students were included in the study. A majority, 230(81%), identified stroke as a disease indicating a medical emergency. The knowledge score was poor in 54.2%, satisfactory in 40.5%, and good in only 5.3% of cases. Forty-four percent of participants had positive attitudes, and 56.0% had negative attitudes concerning strokes. Most participants identified high blood pressure and high cholesterol levels (82.7% and 72.5%, respectively) as risk factors for stroke. Diabetes and irregular heartbeat were the risk factors with the lowest probability (34.5% and 33.1%, respectively).

***Conclusions***: This study shows that university students' knowledge, attitudes, and behaviors regarding stroke are weak, highlighting the urgent need to develop educational and awareness initiatives for better health promotion among university students. The health belief model's guidelines should be used while creating such programs.**(International Journal of Biomedicine. 2023;13(2):326-332.)**

**Keywords:** knowledge • attitude • practice • stroke • risk factor

## Introduction

A stroke, according to the World Health Organization, is defined as "rapidly developing clinical indications of focal (global) impairment of brain function, lasting more than 24 hours or leading to death, with no clear cause other than vascular origin.". Around 15 million individuals globally and 795,000 in the United States experience a stroke yearly.[1] About one in six people will have a stroke at some time.[2] Strokes, as one of the leading causes of death and disability globally, have a physical, social, economic, and emotional impact on patients, their families, and healthcare systems.[3] Numerous kinds of

strokes exist, with ischemic stroke accounting for 67%-80% of stroke cases recorded in epidemiological research. Ischemic stroke is still the most frequent lethal neurological disorder while more often being disabling than fatal.[4] About 10% of ischemic stroke victims pass away within 30 days of onset, and 50% of those who survive have a permanent impairment six months later.[5] Primary intracerebral hemorrhages, which account for 20% of all stroke cases, have a 50% 30-day mortality rate, and intracerebral or subarachnoid hemorrhages, are also potentially fatal conditions.[6-8]

Most stroke sufferers survive the initial injury but live with devastating symptoms for the remainder of their lives,

including aphasia, movement difficulties, blindness, speech problems, despair, and cognitive decline.[9] The consequent decline in the patient's quality of life imposes a tremendous financial and emotional toll on the patient's family and carriers. The high economic cost is frequently consumed, as there is a great need for medical care in the initial phase after a stroke as well as a need for long-term assistance in the late phase.[10]

Stroke prevention is one of the most efficient approaches for lessening the adversarial well-being and economic outcomes of stroke.[11] Despite astounding stroke rates, there are currently only a few approved recovery techniques for reducing ischemia damage or enhancing healing in post-stroke patients' brains.[2] There are two primary ways to enhance stroke recovery. The first is to limit acute ischemia damage by boosting reperfusion to the ischemic region.[12] This can be performed with a variety of procedures, including cerebral angioplasty or thrombolysis. The second technique of recovery is to rehabilitate lost function through relearning.

Stroke prevention and treatment are significantly impacted by timely patient admission to the hospital and improved management of stroke risk factors.[13,14] Stroke risk factors can be classified as modifiable or immutable, with the latter including age, sex, race, and a family history of stroke. Hypertension, cigarette smoking, atrial fibrillation, past stroke or transient ischemic attack (TIA), and inactivity are all regarded as risk factors. Hypertension is the most important and modifiable risk factor for stroke.[15] The last 10 years have seen a rise in interest in improving the quality of life of stroke patients as part of the development of therapeutic approaches.[16] Apart from a lack of basic knowledge about stroke treatment, the majority of patients are unaware of the risk factors for stroke.[17] However, it is disappointing that many stroke patients arrive at the hospital late because of a lack of fundamental knowledge about stroke[18] and its symptoms.[19] Reduced time from stroke onset to hospital presentation and risk reduction depends on patients' and families and the general public's understanding of stroke.[19-21]

Knowledge, attitude, and practice (KAP) connected to stroke risk factors, treatment, and the outcome may aid in early case diagnosis, prevention, and minimization of stroke-associated consequences through prompt hospitalization. There is a shortage of research on KAP and stroke among university students, yet these studies are critical for the development of disease control and prevention methods. Understanding baseline KAP for strokes is a critical first step in developing instructional solutions. Additionally, stroke education for young pupils would be a promising method of widely disseminating stroke knowledge.[22] Therefore, the goal of our study was to identify the KAP of strokes and explore the relationship between KAP and stroke among Majmaah University students.

## Materials and Methods

### Study design

The sample size, a total of 284 participants, was calculated using a 0.50 indicator percentage, a 5% margin of error, and a 95% confidence interval. Undergraduates from the College of Applied Medical Sciences, Majmaah University (Majmaah, KSA), were selected. Students were asked to complete a questionnaire and sign a consent form as part of the research process.

### Questionnaire

The questionnaire had seven questions concerning general information about the participants, such as age, gender, study type (regular or bridging), department, educational level, employment status, and marital status. Even though the questionnaire used to assess KAP comprised three primary categories, namely knowledge, attitude, and practices, the risk factors and warning signs were also included to provide a more accurate assessment of overall illness knowledge. A list of the 12 most significant risk factors of strokes and the 15 most significant warning signs was placed in the questionnaire.

### Knowledge of stroke

Eleven multiple-choice questions were used to assess understanding. Each accurate answer in the knowledge domain was worth one point, whereas each wrong or do not know response resulted in a score of zero. The knowledge portion received a total score range of 0–11 as a result of this. Therefore, Bloom's classification cut-off points for knowledge are as follows: An appropriate knowledge score of 75%-100% was regarded adequate; a suitable knowledge score of 50%-74% was considered satisfactory; and a score of less than 50% was considered poor knowledge.

### Attitude toward stroke

The attitude was the belief and feeling of the respondent toward strokes. Five multiple-choice questions measured attitude. The scoring system for participants' responses was evaluated as follows: True/Yes-1 and False/No-0. The replies were totaled, and a total score was calculated for each participant, as well as an estimate of the total mean score. A positive attitude is associated with a score greater than the mean, and a negative attitude is associated with a score less than the mean.

### Practice toward suspected stroke victim

Implies the immediate action of participants toward anyone showing warning symptoms of a stroke.

### Authentication of the questionnaire

A committee of healthcare professionals thoroughly assessed the questionnaire. Based on the panel's findings, adjustments were made concerning how questions are arranged and structured. In addition, pilot research with 25 randomly selected university students was conducted to confirm validity. A test-retest procedure was used. After seven days, the same group of students were asked to complete the same questionnaire.

Statistical analysis was performed using statistical software package SPSS version 21.0 (SPSS Inc, Armonk, NY: IBM Corp). Baseline characteristics were summarized as frequencies and percentages.

## Results

### Sociodemographic characteristics of the participants

The questionnaire was completed by 284 students (response rate of 100%). The average age of the participants

in this study was 28.3±5.2 years. The majority (59.5%) of participants were in the 26-35 years age group. Fifty-one percent of participants were from the regular study group, and 48.9% were from bridging (Table 1). Forty-one percent of participants were from the Department of Nursing, followed by 18.3% from the Department of Medical Laboratories, 15.5% from Physical Therapy and Rehabilitation, and 13.4% from the Department of Medical Equipment. Most participants (66.9%) were studying at the baccalaureate level, while 19% were studying for a diploma, and 12% were from the master's degree program. In addition to this, 53.5% of participants were employed, and the remaining 46.5% were unemployed. The marital status data showed that 54% of participants were married, while 40.5% were single (Table 1).

*Table 1.*

***Sociodemographic profile of the participants (n = 284)***

| Characteristics | No. of Participants | Percent |
|---|---|---|
| Age | | |
| 15-25 | 98 | 34.5 |
| 26-35 | 169 | 59.5 |
| 36-45 | 17 | 6.0 |
| Gender | | |
| Male | 197 | 69.4 |
| Female | 87 | 30.6 |
| Study Type | | |
| Regular | 145 | 51.1 |
| Bridging | 139 | 48.9 |
| Department | | |
| Physical Therapy (PHT) | 44 | 15.5 |
| Nursing (NRS) | 117 | 41.2 |
| Medical Laboratories (MDL) | 52 | 18.3 |
| Radiology (RMI) | 23 | 8.1 |
| Public Health (PBH) | 10 | 3.5 |
| Medical Equipment (MET) | 38 | 13.4 |
| Educational Level | | |
| Diploma | 54 | 19.0 |
| Bachelor | 190 | 66.9 |
| Master | 34 | 12.0 |
| Doctorate | 6 | 2.1 |
| Employment status | | |
| Yes | 152 | 53.5 |
| No | 132 | 46.5 |
| Marital Status | | |
| Married | 153 | 53.9 |
| Divorced/Separated | 15 | 5.3 |
| Widowed | 1 | 0.4 |
| Single | 115 | 40.5 |

### Sources of information for achieving knowledge of stroke

The source of stroke information was obtained mostly (31.3%) from friends and relatives. Further, radio (28.2%) and television (19%) also significantly contributed to spreading the knowledge of strokes among the participants. In addition, other information sources about stroke were medical and nursing staff (11.3%), the Internet (6.3%), and books & pamphlets (3.9%).

### Information regarding the history of stroke among family members, relatives, or friends

When the participants were asked about a family member, other relative, or friend who had suffered from a stroke, about 41.9% responded that they have at least one member who suffered from a stroke, and only 4.6% recalled having more than one member suffering from a stroke. Strikingly, 35.9% of participants reported that there was no one among family, friends, or relatives suffering from a stroke. More specifically, it was observed that there were more men (66.9%) than women (33.1%) relatives who had a stroke. It was noted that among the men's relatives, mostly father, uncle, and grandfather were reported as having a history of strokes, and aunt and mother were among the women's relatives.

### The practice of immediate action of participants toward anyone showing warning symptoms of stroke

The majority of participants (85.9%) reported that if they found anyone showing warning symptoms of stroke, the immediate action that they would take would be to call an ambulance. Other participants reported that they would tell someone, for example, a family member, friend, or neighbor (78.9%), to drive them to the nearest healthcare center (78.5%), advise them to take rest (71.1%), and bring the person to a general practitioner (70.8%) if they find them still showing warning symptoms of stroke (Table 2).

*Table 2.*

***The practice of immediate action of participants toward anyone showing warning symptoms of stroke***

| Practice Pattern | Frequency | Percent |
|---|---|---|
| Call an ambulance | 244 | 85.9 |
| Tell someone for example family member, friend, or neighbor | 224 | 78.9 |
| Drive them to the nearest healthcare center | 223 | 78.5 |
| Advise them to take rest | 202 | 71.1 |
| Bring the person to a general practitioner | 201 | 70.8 |
| Give something, for example, aspirin or a headache medication | 198 | 69.7 |
| Take time to allow spontaneous recovery | 113 | 39.8 |
| I don't know | 15 | 5.3 |

### Risk factors associated with stroke

Data analysis regarding the risk factors associated with stroke showed that most participants believed that high blood pressure (82.7%) is a major risk factor for stroke (Table 3). High cholesterol levels (72.5%) and cigarette smoking (70.4%) were considered the next crucial contributing risk factors. In addition

to this, the other risk factors for stroke were high blood sugar (42.2%) and a history of having a heart attack (36.6%).

*Table 3.*

***Risk factors of stroke identified by the participants.***

| Risk factors | Frequency | Percent |
|---|---|---|
| High blood pressure | 235 | 82.7 |
| High cholesterol levels | 206 | 72.5 |
| Cigarette smoking | 200 | 70.4 |
| Obesity or overweight | 190 | 66.9 |
| High blood sugar | 120 | 42.2 |
| History of having a heart attack | 104 | 36.6 |
| Diabetes | 98 | 34.5 |
| Irregular heartbeat | 94 | 33.1 |
| Lack of physical activity | 91 | 32 |
| Excessive alcohol consumption | 37 | 13.0 |
| History of stroke among family members | 24 | 8.5 |
| Light to moderate coffee consumption (3-4 cups per day) | 21 | 7.4 |

Sudden onset of warnings signs of stroke

The most commonly reported (56.3%) warning sign for sudden onset of stroke was a sudden loss of speech or inability to explain oneself in words and severe headache with flashing lights (48.9%). Other reported warning indications of a stroke beginning were weakness or numbness of the face, especially on one side of the body (44.0%), sudden confusion (43.3%), and inability to talk due to quick onset of back pain (43.0%) (Table 4).

Knowledge about stroke

Most (74.6%) of the students were aware of stroke from reading or hearing about it and most (81%) considered stroke a medical emergency. Nearly half of the students identified ischemic stroke as the most common type of stroke. Further, only 46.5% believed exercise is the most helpful way to reduce stroke occurrence. Also, 46.1% of participants recognized that both blood tests and CT scans could be used to diagnose stroke. Less than half (44.7%) of the respondents knew that stroke is more common in men than females. Only 41.2% of the students properly understood a stroke-affected part or organ. A blood clot in the brain was cited as a stroke sign by about 40% of individuals. About 32.7% of students knew that physiotherapy and medication could help them recover from a stroke. Less than one-third (29.2%) of students could figure out the prevalence of stroke in Saudi Arabia (Table 5A).

Attitude toward stroke

About half of the participants (54.6%) showed a positive attitude toward procedures like thrombectomy, angioplasty, and stenting done for stroke patients. An almost equal number of participants (48.2%) answered correctly for stroke survivors suffering from post-stroke depression. However, only 27.1% of students were aware of aspirin and warfarin as the most common drug prescribed for stroke. Further, 23.9% of students showed a negative attitude toward full recovery after a stroke (Table 5B).

*Table 4.*

***Warning signs of stroke identified by the participants.***

| Warning signs | Frequency | Percent |
|---|---|---|
| Sudden loss of speech or inability to express oneself in words | 160 | 56.3 |
| Severe headache with flashing lights and nausea | 139 | 48.9 |
| Weakness or numbness of the face, especially one side of the body | 125 | 44.0 |
| Sudden confusion | 123 | 43.3 |
| Inability to talk due to the sudden onset of a backache | 122 | 43.0 |
| Sudden onset of vertigo, imbalance, and clumsiness of limbs | 113 | 39.8 |
| Sudden onset of unconsciousness with generalized convulsion and incontinence | 105 | 37.0 |
| Neck stiffness | 95 | 33.4 |
| Shoulder pain | 86 | 30.3 |
| Sudden trouble seeing in one or both eyes | 86 | 30.3 |
| Sudden loss of appetite with abdominal pain, nausea, and diarrhea | 77 | 27.1 |
| Urinary urgency | 56 | 19.7 |
| Weakness or numbness of leg, especially one side of the body | 55 | 19.4 |
| Weakness or numbness of the arm, especially one side of the body | 54 | 19.0 |
| Any mention of Face, Arm, Speech, Time (FAST) | 24 | 8.5 |

*Table 5.*

***Knowledge and Attitude toward stroke***

| (A). Knowledge about stroke | Frequency | Percent |
|---|---|---|
| Stroke is a medical emergency | 230 | 81.0 |
| Have you heard of a condition called 'Stroke'? | 212 | 74.6 |
| Stroke is due to a lack of blood supply to the brain | 168 | 59.2 |
| The most common type of stroke is an ischemic stroke | 149 | 52.5 |
| Which of these could help reduce the chance of stroke… | 132 | 46.5 |
| Diagnosis of stroke can be made by… | 131 | 46.1 |
| Stroke is more common among men | 127 | 44.7 |
| Which part/organ of the body is affected in Stroke? | 117 | 41.2 |
| Which of the following is suggestive of stroke? | 115 | 40.5 |
| Most useful methods for recovery are.. | 93 | 32.7 |
| Can you estimate how many people have a stroke in Saudi Arabia? | 83 | 29.2 |

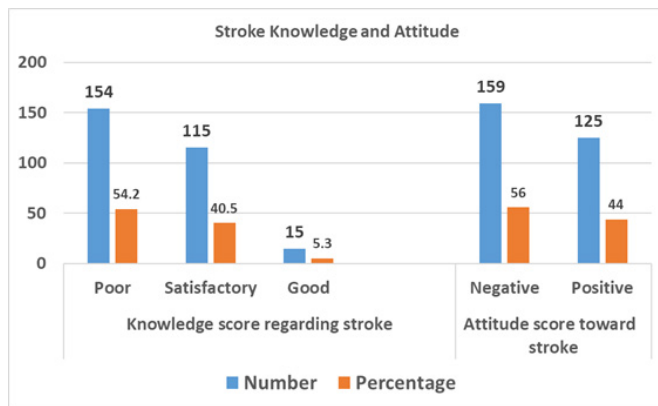| (B). Attitude toward stroke | | |
|---|---|---|
| Is thrombectomy, angioplasty and stenting done for stroke? | 155 | 54.6 |
| Stroke survivors suffer from post-stroke depression. | 137 | 48.2 |
| Is there any current treatments for stroke? | 121 | 42.6 |
| Drugs prescribed for stroke are aspirin and warfarin | 77 | 27.1 |
| Nobody makes a full recovery after a stroke | 68 | 23.9 |

***Fig. 1.*** *Knowledge and attitude score of included subjects*

The knowledge score was poor in 54.2%, satisfactory in 40.5%, and good in only 5.3% of cases. Forty-four percent of participants had positive attitudes, and 56.0% had negative attitudes concerning strokes (Figure 1).

## Discussion

Despite breakthroughs in understanding the mechanism of cerebral ischemia, treatment options for ischemic stroke remain limited.[21] Although modern medicine has eradicated or significantly curtailed many diseases, the incidence of stroke continues without significant change. Stroke has not been completely eliminated by preventive efforts that tackle the risk factors, and it typically still manifests as the population's first symptom.[23]

Stroke is a significant cause of hospitalization, lengthy hospital stays, chronic disability, cognitive impairment, and death.[24,25] Stroke causes a devastating impact on individuals, families and caregivers, primary care, acute hospitals, and purchasers of health care, along with policymakers.[26]

This study is the first to study the KAP among university students at the College of Applied Medical Sciences. This study demonstrates poor attitudes, practices, and awareness of risk factors and warning signs for stroke. In this study, most students (60%) were aged 26-35 years. About two-thirds of the participants were male. An almost equal number of participants were full-time (regular) or part-time (bridging). Further, it was found that most of the students participating in this study were from nursing (41.2%) and were involved in the graduation program. Half of the participants were employed, and the remaining half were unemployed. More than half of the students (53.9%) were married, while 40.5% were single. Most of the participants could not recall having anyone in the family, or were ignorant of anyone in the family, having episodes of stroke. About 42.2% of participants had a single-family member suffering a stroke. This study supported the idea that men are more likely than women to get a stroke. It was also evident from the current study that calling an ambulance and informing the family members, friends, or neighbors, and carrying the patient to the nearest healthcare center was the most immediate action taken by anyone suspecting a patient was having a stroke.

People with hypertension were more likely to have a sudden loss of speech or an inability to communicate verbally as a sign of an impending heart attack. Stress and smoking were the two most frequent risk factors, whereas double and fuzzy vision or complete blindness were the most frequent warning signs.[27] Similarly, in a national study of Koreans, Paresis was the most prevalent symptom, while hypertension was the most frequent risk factor.[28] Students in this study had a limited understanding of the signs and symptoms of a stroke. According to the Korean study, most participants were unaware of the warning signs of a stroke.[29]

Most participants perceive stroke as a medical emergency and a brain disorder. Similar findings from research on an Australian urban population indicated that 73% of respondents accurately identified the brain as the target organ of a stroke.[27] In contrast, results obtained in a Northwest India study showed that most respondents could not identify a stroke as a brain disease.[30] About three-fifths of students knew that stroke is caused by inadequate blood flow to the brain. About half of the participants were aware of the many types of stroke, and that ischemic stroke is the most prevalent type of stroke. An equal number of students responded to exercise as the means for reducing stroke, and further, both the CT scan and blood test can be used as a means of diagnosis of stroke. Forty-four percent of participants identified stroke to be more common in men. Only one-third of the participants believed that post-stroke recovery is possible through medication and physical therapy. The science of stroke rehabilitation has made enormous strides in recent years.[31] Astonishingly, one-third of the participants seem to have no clue about the prevalence of stroke in Saudi Arabia.

One-third of students acquired their basic knowledge regarding stroke from friends and relatives, and one-third gained their knowledge through the radio. Such a high degree of familiarity with stroke may be associated with more intimate interpersonal and interfamily interactions in these locations. More than half the number of participants had a positive attitude toward thrombectomy, angioplasty, and stenting done for stroke. Almost half of the participants believed that the patient who had suffered from a stroke would undergo depression. Only a quarter of the participants had a negative attitude in believing that after a stroke, the patient could have a full recovery. The knowledge score was found to be poor among most of the participants (54.2%), satisfactory in 40.5%, and good in only 5.3%. A U.K. study[32] had identical findings, indicating that most nursing students (91.5%) had only a basic understanding of the risk factors for stroke. More than half of the participants (56.0%) had overall negative attitudes toward stroke compared to those who showed a positive attitude (44.0%).

KAP studies have several limitations. KAP studies rely on self-reported data, which can be subject to bias and inaccuracies. In addition, the small sample size may constrain the results being generalized to a larger population. KAP studies typically focus on understanding knowledge and attitudes but do not always provide insight into the reason for certain behaviors. KAP studies are often observational and do not provide direct evidence of cause and effect. Finally,

the KAP studies may need to be more generalizable across different cultures, as knowledge, attitudes, and practices may vary significantly.

## Ethical Considerations

The study was approved by the Ethics Committee of the at Majmaah University, Kingdom of Saudi Arabia. After a complete description of the study, written informed consent was obtained from all participants. All identifiable information about participants was removed, and the data were coded to ensure anonymity.

## Acknowledgments

The authors would like to acknowledge the Deanship of Scientific Research, Majmaah University, Saudi Arabia, under project No. R-2023-402.

## Competing Interests

The authors declare that they have no competing interests.

## References

1. Strong K, Mathers C, Bonita R. Preventing stroke: saving lives around the world. Lancet Neurol. 2007 Feb;6(2):182-7. doi: 10.1016/S1474-4422(07)70031-5.

2. WRITING GROUP MEMBERS; Lloyd-Jones D, Adams RJ, Brown TM, Carnethon M, Dai S, De Simone G, Ferguson TB, Ford E, Furie K, Gillespie C, Go A, Greenlund K, Haase N, Hailpern S, Ho PM, Howard V, Kissela B, Kittner S, Lackland D, Lisabeth L, Marelli A, McDermott MM, Meigs J, Mozaffarian D, Mussolino M, Nichol G, Roger VL, Rosamond W, Sacco R, Sorlie P, Roger VL, Thom T, Wasserthiel-Smoller S, Wong ND, Wylie-Rosett J; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics--2010 update: a report from the American Heart Association. Circulation. 2010 Feb 23;121(7):e46-e215. doi: 10.1161/CIRCULATIONAHA.109.192667. Epub 2009 Dec 17. Erratum in: Circulation. 2010 Mar 30;121(12):e260. Stafford, Randall [corrected to Roger, Véronique L]. Erratum in: Circulation. 2011 Oct 18;124(16):e425.

3. Feigin VL, Lawes CM, Bennett DA, Barker-Collo SL, Parag V. Worldwide stroke incidence and early case fatality reported in 56 population-based studies: a systematic review. Lancet Neurol. 2009 Apr;8(4):355-69. doi: 10.1016/S1474-4422(09)70025-0.

4. Biller J, Ferro JM. Evidence-based Management of Stroke. tfm Publishing Limited; 2011.

5. Warlow CP, Dennis M, Van Gijn J, Hankey G, Sandercock P, Bamford J, et al. Stroke: a practical guide to management. Blackwell Science Oxford; 1996.

6. Broderick J, Connolly S, Feldmann E, Hanley D, Kase C, Krieger D, Mayberg M, Morgenstern L, Ogilvy CS, Vespa P, Zuccarello M; American Heart Association/American Stroke Association Stroke Council; American Heart Association/American Stroke Association High Blood Pressure Research Council; Quality of Care and Outcomes in Research Interdisciplinary Working Group. Guidelines for the management of spontaneous intracerebral hemorrhage in adults: 2007 update: a guideline from the American Heart Association/American Stroke Association Stroke Council, High Blood Pressure Research Council, and the Quality of Care and Outcomes in Research Interdisciplinary Working Group. Circulation. 2007 Oct 16;116(16):e391-413. doi: 10.1161/CIRCULATIONAHA.107.183689.

7. Bederson JB, Connolly ES Jr, Batjer HH, Dacey RG, Dion JE, Diringer MN, Duldner JE Jr, Harbaugh RE, Patel AB, Rosenwasser RH; American Heart Association. Guidelines for the management of aneurysmal subarachnoid hemorrhage: a statement for healthcare professionals from a special writing group of the Stroke Council, American Heart Association. Stroke. 2009 Mar;40(3):994-1025. doi: 10.1161/STROKEAHA.108.191395.

8. Fogelholm R, Murros K, Rissanen A, Avikainen S. Long term survival after primary intracerebral haemorrhage: a retrospective population based study. J Neurol Neurosurg Psychiatry. 2005 Nov;76(11):1534-8. doi: 10.1136/jnnp.2004.055145.

9. Dobkin BH. Clinical practice. Rehabilitation after stroke. N Engl J Med. 2005 Apr 21;352(16):1677-84. doi: 10.1056/NEJMcp043511.

10. 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 May 27;367(9524):1747-57. doi: 10.1016/S0140-6736(06)68770-9.

11. Wolf PA. Prevention of stroke. Lancet. 1998 Oct;352 Suppl 3:SIII15-8. doi: 10.1016/s0140-6736(98)90089-7.

12. Murphy TH, Corbett D. Plasticity during stroke recovery: from synapse to behaviour. Nat Rev Neurosci. 2009 Dec;10(12):861-72. doi: 10.1038/nrn2735.

13. National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group. Tissue plasminogen activator for acute ischemic stroke. N Engl J Med. 1995 Dec 14;333(24):1581-7. doi: 10.1056/NEJM199512143332401.

14. G SB, Choi S, Krishnan J, K R. Cigarette smoke and related risk factors in neurological disorders: An update. Biomed Pharmacother. 2017 Jan;85:79-86. doi: 10.1016/j.biopha.2016.11.118.

15. Marwat MA, Usman M, Hussain M. Stroke and its relationship to risk factors. Gomal Journal of Medical Sciences. 2009;7(1):17-21.

16. Hachinski V. Post-stroke depression, not to be underestimated. Lancet. 1999 May 22;353(9166):1728. doi: 10.1016/S0140-6736(99)00139-7.

17. Billett J. Knowledge about Stroke in Adults from Rural Communities. 2001. Masters Theses. 582. https://scholarworks.gvsu.edu/theses/582

18. Abraham SV, Krishnan SV, Thaha F, Balakrishnan JM, Thomas T, Palatty BU. Factors delaying management of acute stroke: An Indian scenario. Int J Crit Illn Inj Sci. 2017 Oct-Dec;7(4):224-230. doi: 10.4103/IJCIIS.IJCIIS_20_17.

***Corresponding author:*** *Dr. Nagi Ibrahim Ali. Department of Radiological Sciences and Medical Imaging, College of Applied Medical Sciences, Majmaah University, Majmaah 11952, KSA. E-mail:* ni.ali@mu.edu.sa

19. Kelly AJ. The Association of Stroke Diagnosis on Knowledge of Stroke Signs and Symptoms, D'Youville College; 2017.

20. Park M-S. Intravenous Thrombolytic Therapy. In: Acute Ischemic Stroke. Springer; 2017:99-124.

21. Donnan GA, Davis SM, Chambers BR, Gates PC, Hankey GJ, McNeil JJ, Rosen D, Stewart-Wynne EG, Tuck RR. Streptokinase for acute ischemic stroke with relationship to time of administration: Australian Streptokinase (ASK) Trial Study Group. JAMA. 1996 Sep 25;276(12):961-6.

22. Thapa L, Sharma N, Poudel RS, Bhandari TR, Bhagat R, Shrestha A, Shrestha S, Khatiwada D, Caplan LR. Knowledge, attitude, and practice of stroke among high school students in Nepal. J Neurosci Rural Pract. 2016 Oct-Dec;7(4):504-509. doi: 10.4103/0976-3147.188635.

23. Sacco RL, Adams R, Albers G, Alberts MJ, Benavente O, Furie K, et al.; American Heart Association/American Stroke Association Council on Stroke; Council on Cardiovascular Radiology and Intervention; American Academy of Neurology. Guidelines for prevention of stroke in patients with ischemic stroke or transient ischemic attack: a statement for healthcare professionals from the American Heart Association/American Stroke Association Council on Stroke: co-sponsored by the Council on Cardiovascular Radiology and Intervention: the American Academy of Neurology affirms the value of this guideline. Circulation. 2006 Mar 14;113(10):e409-49.

24. Du AT, Schuff N, Laakso MP, Zhu XP, Jagust WJ, Yaffe K, Kramer JH, Miller BL, Reed BR, Norman D, Chui HC, Weiner MW. Effects of subcortical ischemic vascular dementia and AD on entorhinal cortex and hippocampus. Neurology. 2002 Jun 11;58(11):1635-41. doi: 10.1212/wnl.58.11.1635.

25. Rockwood K, Wentzel C, Hachinski V, Hogan DB, MacKnight C, McDowell I. Prevalence and outcomes of vascular cognitive impairment. Vascular Cognitive Impairment Investigators of the Canadian Study of Health and Aging. Neurology. 2000 Jan 25;54(2):447-51. doi: 10.1212/wnl.54.2.447.

26. Anderson CS, Linto J, Stewart-Wynne EG. A population-based assessment of the impact and burden of caregiving for long-term stroke survivors. Stroke. 1995 May;26(5):843-9. doi: 10.1161/01.str.26.5.843.

27. 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 Aug;32(8):1926-30. doi: 10.1161/01.str.32.8.1926.

28. Kim YS, Park SS, Bae HJ, Heo JH, Kwon SU, Lee BC, Lee SH, Oh CW, Yoon BW. Public awareness of stroke in Korea: a population-based national survey. Stroke. 2012 Apr;43(4):1146-9. doi: 10.1161/STROKEAHA.111.638460.

29. Kim HK, Jeong SH, Kang HC. [Identification of subgroups with lower level of stroke knowledge using decision-tree analysis]. J Korean Acad Nurs. 2014 Feb;44(1):97-107. [Article in Korean]. doi: 10.4040/jkan.2014.44.1.97.

30. Pandian JD, Kalra G, Jaison A, Deepak SS, Shamsher S, Singh Y, Abraham G. Knowledge of stroke among stroke patients and their relatives in Northwest India. Neurol India. 2006 Jun;54(2):152-6; discussion 156.

31. Bernhardt J, Cramer SC. Giant steps for the science of stroke rehabilitation. Int J Stroke. 2013 Jan;8(1):1-2. doi: 10.1111/ijs.12028.

32. Mason-Whitehead E, Ridgway V, Barton J. Passed without a stroke: a UK mixed method study exploring student nurses' knowledge of stroke. Nurse Educ Today. 2013 Sep;33(9):998-1002. doi: 10.1016/j.nedt.2012.07.021.