

# Effectiveness of an educational program on improving healthcare providers' knowledge of acute stroke: A randomized block design study

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**BACKGROUND:** Stroke is a time-sensitive neurological disease and a life-threatening medical condition. Providing timely management for stroke patients is a crucial issue in healthcare settings. The primary objective of this study is to evaluate the effectiveness of an evidence-based educational program on healthcare providers' (HCPs) overall knowledge of stroke.

**METHODS:** A randomized block design with post-test only was used. A total of 189 HCPs (physicians, registered nurses, and paramedics) involved with treating stroke patients in the emergency were recruited. Participants were randomly assigned to either the intervention or waiting list control group. A one-session, stroke educational program was offered to the HCPs followed by a post-test designed to assess knowledge about stroke.

**RESULTS:** A significant main effect on the profession type was found, with physicians having higher mean scores of stroke knowledge compared with nurses and paramedics ( $F [2, 183]=48.55, P<0.001$ ). The implemented educational program had a positive effect on increasing the level of stroke knowledge among HCPs ( $F [1, 183]=43.31, P<0.001$ ). The utilization of any evidence-based assessment tools for patients with suspected stroke was denied by 36% of the total sample.

**CONCLUSIONS:** The implemented intervention can increase HCP's knowledge regarding stroke. Stroke education should be considered as one of the essential requirements for professional development for all HCPs in the emergency.

**KEYWORDS:** Stroke; Misdiagnosis; Healthcare providers' knowledge; Stroke knowledge

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## INTRODUCTION

Stroke is a time-sensitive neurological disease and a life-threatening medical condition. According to the American Heart Association statistics, approximately 11.8% of worldwide deaths are due to stroke, which is considered as a global cerebrovascular problem.<sup>[1]</sup> Stroke is accompanied by intense negative impacts on survivors' physical, psychological, and social functioning. Stroke is the second leading cause of death after heart disease and is a leading cause of permanent disability and handicaps in adults.<sup>[1]</sup> The World Health Organization (WHO) indicates that approximately 80% of stroke deaths occur in low- and middle-income countries (LMICs).<sup>[2]</sup> Regardless of major improvements in its management

over the last few decades, stroke is still a deadly disease that is on the rise because of an aging population worldwide and the epidemiological transition in LMICs, and one of these countries is Jordan.<sup>[3,4]</sup> Approximately 12% of the total deaths in Jordan result from stroke, and it is the third leading cause of death in the country.<sup>[5]</sup> The burden of stroke is expected to continuously increase in the future in Jordan because of the expected demographic changes.

It is recommended that stroke diagnosis must be initiated within 25 minutes.<sup>[6,7]</sup> The reason is that every minute of delay in treating stroke may result in an average of 1.8 days of healthy life lost.<sup>[8]</sup> Delays in timely recognition and management of stroke could be

attributed to at least two factors. Firstly, the process of conducting a proper assessment is lengthy and requires time. Secondly, it is common to misdiagnose stroke and confuse stroke with other common neurological conditions, such as seizures and migraine, which may lead to an unnecessary delay in providing proper treatment.<sup>[6]</sup> As a result, stroke becomes one of the most commonly misdiagnosed diseases.<sup>[9]</sup> Therefore, early and timely intervention by healthcare providers (HCPs) is vital to significantly reduce the severity and impact of stroke and reduce long-term disabilities.

The timely treatment of stroke enhances the opportunity of achieving excellent outcomes.<sup>[10]</sup> However, one of the most important factors that affect initiating appropriate treatment action by HCPs is to make an accurate diagnosis and a timely treatment plan.<sup>[11]</sup> Paramedics and emergency department (ED) personnel must be trained to accurately identify patients who are exhibiting symptoms of stroke using quick and standardized tests.<sup>[12]</sup> Triage at the ED after hospital arrival is also important. Surprisingly, some published reports suggest that paramedics may fail to recognize over half of stroke cases because pre-hospital scales are either less effective in clinical practice or are not utilized adequately by pre-hospital providers.<sup>[13,14]</sup> Surely, HCPs must utilize evidence-based knowledge and resources when providing care for patients suffering stroke to ensure optimistic clinical outcomes.

There is evidence that HCPs' education regarding stroke is still fragmented.<sup>[15]</sup> Moreover, it is reported that there are many hospitals that do not force HCPs to implement and follow evidence-based protocols regarding stroke management.<sup>[16]</sup> Continuing education (CE) and professional development could facilitate preparing competent and well-trained HCPs capable of recognizing and providing high-quality care to stroke patients. Therefore, the primary objective of this study is to evaluate the effectiveness of an evidence-based educational program on HCPs' knowledge of stroke, risk factors, warning signs, and proper course of diagnosis. The secondary objectives are to compare physicians', nurses' and paramedics' abilities to identify stroke signs and symptoms, and to assess HCPs' knowledge and utilization of evidence-based resources regarding stroke care.

## METHODS

### Design

The study was conducted using a randomized block

design with post-test only. In this study, the researchers decided to divide the sample into three blocks (i.e., groups): physicians, nurses, and paramedics. This randomized block design removed the type of profession as a potential source of variability and as a potential confounding variable. Within each of the three blocks, the researchers assigned the participants into either the intervention or waiting list control group.

### Setting

The study was done at the EDs of three major hospitals. In addition, paramedics from the Jordanian Civil Defense were involved in the study.

### Sampling and participants

The purposive sampling method was used to recruit the study participants after explaining and discussing the study's purpose, procedures, and potential benefits and risks with potential participants. HCPs (physicians, nurses, and paramedics) who met the following inclusion criteria were invited to participate in this study: (1) age  $\geq 18$  years; (2) willing to attend the designed educational intervention program; and (3)  $\geq$  six months of work experience in either the ED or the Jordanian Civil Defense paramedic system.

The required sample size was calculated using G\*Power analysis with an estimated overall sample size of 192 participants. Sixty-four participants for each group (physicians, nurses, and paramedics) were recruited in this study. Then, 32 participants in each group were randomly assigned to either the intervention or waiting list control group. Eligible participants in this study were randomly assigned in a 1:1 ratio to the intervention or the control group according to a random table schedule. Participants in the intervention group were asked to attend a two-hour stroke education program for each session. Participants in the waiting list control group were offered the opportunity to attend the stroke education program one-month post-data collection.

### Intervention

The stroke education program was designed by the researchers and reviewed by HCPs who were experienced in neurological health problems and health professional education. It involved a PowerPoint presentation given by the researcher. A total of 10 educational sessions were delivered to the intervention group participants. Each educational session lasted for approximately two hours. During each presentation, the focus was on how to recognize stroke and its risk factors,

as well as the warning signs and the appropriate medical intervention required to treat stroke in the emergency.

The following topics were covered in the educational sessions: (1) risk factors, types, mechanisms, clinical manifestations, and complications of stroke; (2) primary and secondary prevention of stroke; (3) screening and initial assessments of stroke patients; (4) appropriate medical intervention required to treat stroke in the emergency; and (5) helpful evidence-based practice guidelines and tools used to detect and treat stroke patients.

### Procedure

Researchers approached eligible participants and explained the study and its procedure. Packets containing a cover letter explaining the study and informed consent were distributed to the participants. After the presentation of the educational sessions, participants in both groups were asked to individually complete a demographics questionnaire and a test on the knowledge of risk factors, signs and symptoms, diagnosis, and management of stroke. The test was reviewed by HCPs who experienced in neurology and health education. The test items were developed from evidence-based guidelines, professional recommendations, and an extensive review of the stroke literature. Eighteen items were on HCP's knowledge of stroke, and the remaining two questions focused on the utilization of evidence-based resources. Possible scores on the test ranged from 0 to 18, with higher scores indicating a better level of stroke knowledge. Content validity was established by asking three experts to review the test and provide feedback regarding each item of the questionnaire. This panel of experts included professionals with expertise in emergency and neuroscience care as well as health professional education.

A two-way analysis of variance (ANOVA) was used to compare the mean scores of knowledge among three groups of the study using SPSS software (Version 25). Frequencies and descriptive statistics were also used.

## RESULTS

### Participants' characteristics

A total of 189 HCPs (97 in the intervention group and 92 in the control group) completed the questionnaires, with 39% ( $n=74$ ) being women and 61% ( $n=115$ ) being men. Out of the 189 HCPs, 32% ( $n=61$ ) were physicians, 34% ( $n=64$ ) were nurses, and 34% ( $n=64$ ) were paramedics.

### ANOVA analysis

An independent and two-way ANOVA analysis was performed. Post-hoc and follow-up  $t$ -tests were also performed to detect the exact source of mean differences, when present. Using the two-way ANOVA, the average of the dependent variable (DV) and HCP's knowledge were first compared among participants based on their professions and groups (intervention or control). The results showed a statistically significant effect on the profession types ( $F [2, 183]=48.55, P<0.001$ ); a statistically significant effect on the groups (intervention or control) ( $F [1, 183]=43.31, P<0.001$ ); and a non-significant interaction effect ( $F [2, 183]=0.07, P>0.050$ ).

Post-hoc analysis using a Tukey test was performed to compare the mean scores of the DV for the participants based on the type of profession. The results of Tukey post-hoc revealed statistically significant mean differences among the study participants based on the type of profession; physicians had a significantly higher mean score on the stroke knowledge test compared with nurses and paramedics. The results are presented in Table 1.

Because the main effects of the independent variables (IVs) were significant, follow-up analyses were also conducted to determine the exact source of difference for the two IVs: type of profession and group. To determine the source of mean differences in the HCP's knowledge with respect to the profession according to the group, the researcher used the split method to classify the data based on the group, intervention or control. Then, one-way ANOVA analysis was performed twice after adjusting the significance value  $P<0.05\div 2=0.025$ . The adjusted significance level was calculated to avoid the inflation of a type I error. The results revealed statistically significant main differences using the one-way ANOVA test:  $F (2, 89)=23.74, P<0.001$  for the control group; and  $F (2, 94)=24.87, P<0.001$  for the intervention group.

Furthermore, three independent  $t$ -tests were performed to examine the source of difference among HCPs with respect to the group, intervention or control group (Table 2). The significance level was adjusted again and was calculated as  $P<0.05\div 3=0.016$ . The results of the independent  $t$ -tests showed that the intervention group of physicians had a higher score of stroke knowledge compared with the control group of physicians ( $t= -3.58, P=0.001$ ). Nurses in the intervention group also had a statistically significant higher mean score compared with the control group of nurses ( $t= -3.91, P<0.001$ ). Similarly, the intervention group of paramedics had higher mean scores of stroke knowledge compared with the control group ( $t=3.92,$

$P < 0.001$ ), which indicated that there were significant positive improvements in knowledge of stroke in the intervention group compared with the control group.

Regarding the utilization of evidence-based resources by HCPs, the researchers found that 36% of the total participants did not use any scale types in the initial assessment of a patient suspected with stroke. The most frequently used stroke assessment was the Face, Arm, Speech, and Time (FAST) scale.

## DISCUSSION

The findings of the current study, consistent with the results of previous research, highlight the multifaceted nature of stroke HCPs' experiences.<sup>[4]</sup> Understanding and evaluating the educational needs of HCPs regarding stroke is essential to establish beneficial interdisciplinary training. In addition, evaluating the standards and elements of stroke care, as carried out by HCPs in the emergency, facilitates achieving better health outcomes for stroke patients. A review of the literature on health service delivery demonstrates that active educational intervention is more likely to induce changes in practice.<sup>[17]</sup>

The overall program was successful with an improvement of the test scores between intervention and control groups. In addition, the study revealed statistically significant mean differences among the study participants based on the type of profession. Similarly, in Catangui's study,<sup>[18]</sup> a training program developed by a team of professionals with expertise in stroke care aimed to teach each professional involved in many aspects of stroke care. The authors found that the training program was successful in increasing staff knowledge of the care for stroke patients, improving collaboration, and enhancing working practices. These findings were similar

to and supported the results of the current study.

Much acquaintance between knowledge, practice, and performance measurement was reported in the literature.<sup>[19,20]</sup> HCPs involved with stroke management need to be attentive through regular updating of their own knowledge, as ongoing research in the field illuminates greater insights into improved management skills pertinent to stroke care. Despite the reported effectiveness of stroke education in improving health outcomes, Mason-Whitehead and colleagues<sup>[21]</sup> found that there was still insufficient stroke awareness and knowledge. Stroke education is not often provided and is not a prerequisite for emergency medical services (EMS) certification or CE in Jordan. Therefore, educating and training emergency dispatchers is warranted, as it could significantly improve the chances of recognizing stroke cases.<sup>[22]</sup>

It is reported in the literature that education strengthens nurses' knowledge of their role in stroke and helps to define the roles of other HCPs.<sup>[23]</sup> Additionally, implementation of education directed at nurses was found to have a strong potential to increase acute intervention of in-hospital strokes.<sup>[24]</sup> George et al<sup>[24]</sup> stated that most of the acute stroke calls came from nurses. However, nurses were found in the current study to have lower levels of stroke knowledge compared with physicians. Thus, nurses, especially those who work at the ED, are required to stay updated regarding the most valid approaches of detecting and assessing stroke patients in a timely manner.

In the current study, physicians had the highest levels of stroke knowledge. However, the results showed that physicians should also update their stroke knowledge. Specifically, physicians' knowledge regarding the utilization of evidence-based resources should be integrated into CE and certification requirements.

**Table 1.** Post-hoc analysis using a Tukey test

Variables	Profession	Mean difference	P-value	95% confidence interval
Physician	Nurse	1.73	0.001	0.65–2.81
	Paramedic	4.60	<0.001	3.52–5.69
Nurse	Physician	-1.73	0.001	-2.81–-0.65
	Paramedic	2.88	<0.001	1.80–3.95
Paramedic	Physician	-4.60	<0.001	-5.69–-3.52
	Nurse	-2.88	<0.001	-3.95–-1.80

**Table 2.** Overall knowledge score differences for participants classified by groups

Groups	Number	Mean	95% confidence interval	Min.	Max.
Control group					
Physician	28	11.64	10.48–12.81	4.00	15.00
Nurse	31	9.90	9.00–10.80	5.00	14.00
Paramedic	33	7.00	6.09–7.91	1.00	13.00
Total	92	9.39	8.71–10.06	1.00	15.00
Intervention group					
Physician	33	13.94	13.24–14.64	10.00	17.00
Nurse	33	12.33	11.44–13.22	6.00	16.00
Paramedic	31	9.65	8.61–10.69	5.00	17.00
Total	97	12.02	11.42–12.63	5.00	17.00

Min.: minimum score on the test out of 18; Max.: maximum score on the test out of 18.



## Limitations

Despite its strength and suitability for the current study, randomized block design has a number of threats to internal validity. Based on the results of the descriptive statistics, the intervention and control groups were, to an extent, comparable in terms of the major sociodemographic variables like age, experience, and education. A major threat to internal validity, however, was the mortality threat. The original plan of this study was to conduct follow-up tests at two weeks and then three months after implementing the educational sessions. The purpose of such planned follow-up tests was to examine the effectiveness of the implemented program in improving the retention of knowledge among HCPs, but none of these follow-up tests were conducted despite the researchers' endeavors to do so. The participants declined to take the follow-up tests for various reasons, including: (1) job requirements and the busy schedule they had; (2) lack of interest with the study; (3) taking vacations; and (4) being busy preparing for the medical board exam. Regarding the external validity and generalizability of the results, the researcher was able to recruit a minimal number of participants in each group. However, the sample was obtained using a purposive sampling method. In addition, the study was conducted using a post-test only design. Using a pre- and post-test design in the future is warranted.

## CONCLUSIONS

Stroke is a worldwide main concern that requires having a larger number of trained HCPs and collaboration among them. Advancing HCPs' knowledge and skills about stroke management is the starting point to help reduce the overwhelming impact of stroke on patients, their family members, and the healthcare system. The results of this study show that there is a significant improvement in stroke knowledge among HCPs in the intervention group. HCPs should be provided with evidence-based resources on acute stroke care and opportunities to participate in CE. Interdisciplinary collaboration and interprofessional education could help in maximizing the identification of stroke cases and minimizing its impact. Finally, enhanced education and the development of training programs could make a difference in the future regarding stroke care.

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**Conflicts of interest:** The authors declare that they have no competing interests.

**Contributors:** JAR proposed the study and wrote the paper. All authors contributed to the design and interpretation of the study and to further drafts.

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