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The Effect of Training Given to Nurses About Tissue Plasminogen Activator Administered to Patients with Stroke on Anxiety Level

Burcu Başcı[1], Elif Ateş [2]*,

1 Fatih Sultan Mehmet Training and Research Hospital , İstanbul, Turkey

2 Istanbul University Faculty of Nursing, Istanbul, Turkey

Corresponding Author: Elif Ateş **E-mail:** elif.ates@istanbul.edu.tr

Abstract

Objective: The present study aimed to examine the effect of training on tissue plasminogen activator (TPA) administration provided to nurses caring for patients diagnosed with stroke on nurses' anxiety levels.

Material and Methods: This study was designed as a quasi-experimental, single-group pretest–posttest study. The study sample consisted of 50 nurses. Nurses received structured training on TPA administration, and their knowledge and anxiety levels were assessed before the training, immediately after the training, and one month after the training. Data were collected through face-to-face interviews and analyzed using SPSS software.

Results: A statistically significant difference was observed in nurses' knowledge scores regarding TPA administration across the three measurement points ($p<0.01$). In addition, significant differences were found in State and Trait Anxiety Scale scores before the training, after the training, and one month after the training ($p<0.01$). Overall, the findings indicate that improvements in knowledge following the training were accompanied by reductions in anxiety levels among nurses.

Conclusion: The findings suggest that training on TPA administration may contribute to improved professional and reduced anxiety among nurses involved in stroke care.

Keywords: Anxiety Level, Neurology, Nurse, Stroke, TPA

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INTRODUCTION

Stroke is one of the leading causes of mortality worldwide and represents the third most common cause of death in developed countries and the second most common cause of death in Turkey (1). Early intervention in patients diagnosed with stroke is critically important, as the effectiveness of treatment decreases as the time to initiation is prolonged. Therefore, timely diagnosis and early treatment are essential for improving patient outcomes (2).

Intravenous thrombolytic therapy is a widely used treatment method in acute ischemic stroke. When administered promptly, tissue plasminogen activator (TPA) can limit cerebral damage and contribute to improved long-term neurological outcomes. Previous studies have demonstrated that rapid evaluation and early initiation of treatment in stroke patients positively affect neurological function and quality of life (3). Despite its benefits, intravenous thrombolytic therapy carries potential risks and requires careful clinical monitoring. Nurses play a crucial role before, during, and after TPA administration and must remain vigilant regarding possible complications. In particular, the use of thrombolytic agents requires heightened awareness of serious adverse effects, such as intracranial hemorrhage (4).

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Nurses may experience anxiety during the management of TPA administration due to insufficient knowledge, fear of making medication errors, and concerns related to patient safety. In a qualitative study examining nurses' experiences with medication errors, participants reported experiencing intense anxiety, panic, and uncertainty following such incidents (5–7).

Educational interventions aimed at updating nurses' knowledge and clinical skills may enhance professional self-confidence and contribute to the reduction of anxiety. Accordingly, the present study aimed to evaluate the effect of TPA administration training on the anxiety levels of nurses caring for patients diagnosed with stroke.

Hypotheses

H_0: Training provided to nurses regarding TPA administration does not affect nurses' anxiety levels.

H_1: Training provided to nurses regarding TPA administration affects nurses' anxiety levels.

MATERIALS AND METHODS

Study Design

This study was conducted using a quasi-experimental, single-group pretest–posttest design. Randomization could not be performed due to constraints associated with the COVID-19 pandemic. All nurses who were actively working during the study period and voluntarily agreed to participate were included in the study sample.

Study Population and Sample

The study population consisted of nurses who administered TPA to patients diagnosed with stroke in a public hospital in Istanbul between January and March 2022. A priori power analysis was conducted using G*Power 3.1 software. Assuming a medium effect size (Cohen's d = 0.50), an alpha level of 0.05, and a desired statistical power of 0.80, the minimum required sample size was calculated as 56 participants. However, the study was completed with 50 nurses who were willing to participate and were actively working during the pandemic period.

Eligibility criteria included working in the emergency or neurology departments, administering TPA to patients with stroke, not being on leave or transferred to another unit during the study period, and providing informed consent.

Data Collection Tools

Sociodemographic Data Collection Form: This form consisted of 11 items designed to collect information on participants' sociodemographic characteristics.

Information Form on TPA Administration Steps: This form included 28 items evaluated using a five-point Likert-type scale and addressed critical considerations related to the steps of TPA administration (4,8). Knowledge scores were calculated by assigning 2 points to responses of "agree" or "strongly agree," 1 point to "undecided," and 0 points to responses of "disagree" or "strongly disagree." Total scores were converted to a 0–100 scale to standardize the assessment of knowledge levels.

State and Trait Anxiety Scale: The State and Trait Anxiety Scale was developed by Spielberger et al. (1970), and its Turkish validity and reliability study was conducted by Öner (1977). The scale consists of 20 items for each dimension and measures state and trait anxiety separately. Total scores range from 20 to 80, with higher scores indicating higher anxiety levels. A score of 0-19 on the scale means no anxiety, 20-39 means mild anxiety, 40-59 means moderate anxiety, and 60-79 means high anxiety (9,10).

In the present study, Cronbach's alpha coefficients ranged from 0.678 to 0.783 for the Trait Anxiety Scale and from 0.629 to 0.793 for the State Anxiety Scale across measurement points, indicating acceptable internal consistency.

Implementation of Data Collection Tools

Participants were informed about the study objectives, and both written and verbal consent were obtained prior to data collection. Due to staffing shortages, pandemic-related restructuring of clinical units, and on-call working conditions, training sessions were conducted individually.

Training was delivered face-to-face by the researcher using a PowerPoint presentation developed in accordance with current clinical guidelines (4,8). Each training session lasted approximately 30 minutes and was conducted in a quiet and private room within the clinical setting when available. At the end of the training, the presentation was shared with the nurses in order for them to repeat and remember the information given. All data were collected by the researcher. Blinding was not feasible due to the limited number of participating nurses and constraints related to the COVID-19 pandemic.

The learning objectives of the training were structured at three fundamental levels: (1) to discuss the mechanism of action of tissue plasminogen activator (TPA), (2) to explain the clinical indications for TPA use, and (3) to describe the key considerations during TPA administration.

The training content included the mechanism of action of TPA; clinical conditions in which TPA is indicated; precautions to be considered prior to TPA administration in patients diagnosed with stroke; the TPA administration procedure and critical points during implementation; and post-administration care and monitoring.

The training was delivered using a PowerPoint presentation. The effectiveness of the training was evaluated immediately after the intervention and one month later using the Information Form on TPA Administration Steps.

Data Analysis

Data were analyzed using SPSS version 26.0 (Statistical Package for the Social Sciences). Descriptive and inferential analyses were performed using Student's t-test, one-way analysis of variance (ANOVA), Bonferroni post-hoc tests, and the Friedman test, as appropriate. Intragroup comparisons across repeated measurements were conducted using repeated-measures techniques.

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All statistical analyses were evaluated at a 95% confidence interval, with statistical significance set at $p<0.05$. The normality of continuous variables and difference scores across repeated measurements was assessed using the Shapiro–Wilk test, along with visual inspection of histograms and Q–Q plots. For outcome variables that met parametric assumptions, specifically the State and Trait Anxiety Scale scores, repeated-measures ANOVA was applied. When normality assumptions were violated, as observed for the Knowledge Score on TPA Administration due to ceiling effects in post-test measurements, the Friedman test was employed. Post-hoc pairwise comparisons were performed using Dunn–Bonferroni or Wilcoxon signed-rank tests, as appropriate.

The selection of statistical tests was based on the distributional characteristics of each outcome variable rather than on the similarity of measurement time points. Subgroup analyses were conducted for exploratory purposes. However, due to small sample sizes in certain subgroups, particularly in unit-based comparisons, these findings should be interpreted with caution because of the increased risk of type II error. Accordingly, both the selection of statistical tests and the interpretation of results were guided by distributional assumptions and the exploratory nature of some comparisons.

Ethical Considerations

Ethics committee approval was obtained prior to the initiation of the study (Approval No: 2021-21/51). Written permission was secured from the institutions where the study was conducted. Permission to use the measurement scale was obtained, and written informed consent was collected from all nurses who voluntarily participated in the study.

Limitations

This study has several limitations. First, as the data collection period coincided with the COVID-19 pandemic and appointment processes, collective training sessions could not be conducted due to the limited number of nurses available in clinical settings. Second, the study was conducted using a quasi-experimental, single-group design, which does not allow for causal inferences; therefore, the findings should be interpreted at the level of associations within the study sample only.

Another important limitation is the lack of expert opinion for the content validation of the Information Form on TPA Administration Steps, which was used to assess nurses' knowledge regarding TPA administration. Although the form was developed based on the relevant literature, the absence of formal content validation by subject-matter experts may limit the interpretability and generalizability of the knowledge assessment results.

RESULTS

Of the nurses who participated in the study, 82% (n=41) were female, 54% (n=27) were aged between 24 and 29 years, and 28% (n=14) were aged 30 years or older. In terms of marital status, 68% (n=34) were single. Most participants held an undergraduate degree (78%, n=39), and 78% (n=39) had been working in the nursing profession for five years or less. Descriptive characteristics of the participants are presented in **Table 1**.

Comparison of Knowledge and Anxiety Scores Before and After Training

A statistically significant difference was observed in nurses' knowledge test scores regarding TPA administration across the three measurement points (pre-test, post-test, and one-month post-test) ($p=0.001$; $p<0.01$) (Table 2). The mean increase in knowledge scores was 17.32±15.35 points immediately after the training and 12.32±8.03 points one month after the training compared to baseline.

Similarly, a statistically significant difference was found in State Anxiety Scale scores across the pre-test, post-test, and one-month post-test measurements ($p=0.001$; $p<0.01$). The mean decrease in state anxiety scores was 10.12±7.23 points immediately after the training and 8.82±6.50 points one month after the training compared to pre-test values (Table 2).

A statistically significant difference was also observed in Trait Anxiety Scale scores across the three measurement points ($p=0.001$; $p<0.01$). Compared with baseline, trait anxiety scores decreased by a mean of 12.48±8.36 points immediately after the training and by 11.28±7.17 points one month after the training (**Table 2**).

Knowledge Score Changes According to Descriptive Characteristics

The changes in knowledge scores regarding TPA administration before and one month after the training did not differ significantly according to gender, age, marital status, education level, years in the profession, years working in the unit, or the method of training received ($p>0.05$) (**Table 3**).

In contrast, statistically significant differences were found in the change in knowledge scores according to the unit of employment, daily working hours, and years worked in the unit ($p=0.001$; $p=0.008$; $p=0.006$; $p<0.01$). Nurses working in the neurology intensive care unit demonstrated significantly smaller increases in knowledge scores compared to those working in the neurology and emergency departments ($p=0.001$; $p<0.01$).

Compared to baseline, the increase in knowledge scores one month after the training was significantly greater among nurses who reported not feeling competent in TPA administration than among those who reported feeling competent ($p=0.011$; $p<0.05$). In addition, nurses who had received distance (online) training during the pandemic exhibited significantly greater improvements in knowledge scores compared to those who had received in-service training ($p=0.001$; $p<0.01$).

Given the single-group repeated-measures design, within-group changes over time were used as the primary indicator of practical significance. The observed mean differences across measurement points indicate that the training produced a meaningful practical effect.

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Changes in State and Trait Anxiety Scores According to Descriptive Characteristics

No statistically significant differences were found in changes in State Anxiety Scale scores across the pre-test, post-test, and one-month post-test according to gender, age, marital status, education level, years in the profession, years working in the unit, training method, or perceived competence in TPA administration ($p>0.05$) (**Table 4**).

However, a statistically significant difference was observed in state anxiety score changes according to the unit of employment ($p=0.008$; $p<0.01$). Nurses working in the emergency department showed significantly smaller reductions in state anxiety scores compared to those working in the neurology intensive care unit and neurology department ($p=0.048$; $p=0.028$; $p<0.05$).

Regarding the Trait Anxiety Scale, no statistically significant differences were found in post-test score changes according to age, education level, years in the profession, years working in the unit, training method, or perceived competence ($p>0.05$). When pre-test and one-month post-test scores were compared, no significant differences were observed according to marital status or years worked in the unit ($p>0.05$).

In contrast, compared with baseline, the reduction in trait anxiety scores immediately after the training was significantly greater among female nurses ($p=0.008$; $p<0.01$), married nurses ($p=0.016$; $p<0.05$), and those who had been working in their unit for less than one year ($p=0.022$; $p<0.05$). Nurses working in the emergency department demonstrated significantly smaller reductions in trait anxiety scores compared to those working in the neurology intensive care unit and neurology department ($p=0.020$; $p=0.009$; $p<0.05$).

Compared to baseline, the decrease in trait anxiety scores at one-month follow-up remained significantly greater among female nurses ($p=0.001$; $p<0.01$). Again, nurses working in the emergency department exhibited smaller reductions in trait anxiety scores than those working in the neurology intensive care unit and neurology department ($p=0.002$; $p<0.01$).

Table 1. Distribution of Descriptive Characteristics

		n (%)
Gender	Female	41 (82.0)
	Male	9 (18.0)
Age	18-23	9 (18.0)
	24-29	27 (54.0)
	≥30	14 (28.0)
Marital status	Married	16 (32.0)
	Single	34 (68.0)
Education level	Secondary Education – Assoc. Degree	11 (22.0)
	Undergraduate Degree	39 (78.0)
Years of in profession	≤5 years	39 (78.0)
	≥6 years	11 (22.0)
Work department	Neurology Intensive Care Unit	9 (18.0)
	Neurology Department	13 (26.0)
	Emergency Department	28 (56.0)
Years of working in the unit	Less than one year	16 (32.0)
	≥ one year	34 (68.0)
TPA training status	Received	50 (100)
Method of training received	In-Service Training	28 (56.0)
	Distance Training (internet, other)	22 (44.0)
Feeling competent in TPA administration	Yes	34 (68.0)
	No	16 (32.0)

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Table 2. Comparison of Knowledge Test, State and Trait Anxiety Scale Scores Before, After, and One Month After TPA Training

Knowledge Score on TPA Administration			**Test Value P**	
Pre-Test	*Mean ± SD* *Median (Min-Max)*	82.67±15.35 85.7 (51.8-100)		
Post-Test	*Mean ± SD* *Median (Min-Max)*	100.00±0.00 100 (100-100)	**Z:58.492** **0.001****	[a]*Friedman Test &* [aa]*Signed Rank Test with Wilcoxon Correction* ***p<0.01*
One month later	*Mean ± SD* *Median (Min-Max)*	95.00±15.15 100 (50-100)		
Change Δ				
Pre-Test – Post-Test	*Mean ± SD* ***P***	17.32±15.35 ***0.001****		
Pre-Test – One month	*Mean ± SD* ***P***	12.32±8.03 ***0.001****		
Post-Test – One month	*Mean ± SD* ***P***	-5.00±15.15 ***0.952***		
State Anxiety Scale Score			**Test Value *P***	
Pre-Test	*Mean ± SD* *Median (Min-Max)*	45.12±5.39 45 (31-57)		
Post-Test	*Mean ± SD* *Median (Min-Max)*	35.00±4.29 35 (26-44)		[d]*Repeated Measures Test &* [dd]*Dunn Bonferroni Test* ***p<0.01*
One month later	*Mean ± SD* *Median (Min-Max)*	36.30±2.49 36.5 (30-41)	**F:78.943** [d]**0.001****	
Change Δ				
Pre-Test – Post-Test	*Mean ± SD* ***P***	-10.12±7.23 [dd]***0.001****		
Pre-Test - One month	*Mean ± SD* ***P***	-8.82±6.50 [dd]***0.001****		
Post-Test - One month	*Mean ± SD* ***P***	1.30±4.53 [dd]***0.144***		
Trait Anxiety Scale Score			**Test Value *P***	
Pre-Test	*Mean ± SD* *Median (Min-Max)*	47.50±6.63 48 (25-60)		
Post-Test	*Mean ± SD* *Median (Min-Max)*	35.32±4.32 36 (25-46)		[d]*Repeated Measures Test &* [dd]*Dunn Bonferroni Test* ***p<0.01*
One month later	*Mean ± SD* *Median (Min-Max)*	36.52±2.43 36 (32-42)	**F:96.536** [d]**0.001****	
Change Δ				
Pre-Test – Post-Test	*Mean ± SD* ***P***	-12.48±8.36 [dd]***0.001****		
Pre-Test – One month	*Mean ± SD* ***P***	-11.28±7.17 [dd]***0.001****		
Post-Test – One month	*Mean ± SD* ***P***	1.20±5.09 [dd]***0.306***		

aFriedman Test & aaWilcoxon Düzeltmeli Signed Rank Test **p<0,01
dRepated Measures Test & ddDunn Bonferroni Test *p<0,01

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Table 3. Comparison of the Difference in Scores of Knowledge on TPA Administration Before and After TPA Training in Terms of Descriptive Characteristics

		Knowledge Score on TPA Administration (Before Training - After Training)			Knowledge Score on TPA Administration (Before Training - One month After Training)		
		Mean ± SD	Median (Min-Max)	*p / Test value*	Mean ± SD	Median (Min-Max)	*p / Test value*
Gender	**Female**	18.34±16.31	14.3 (0-48.2)	[b]***0.323***	12.24±17.09	7.1 (-19.6-46.4)	[b]***0.938***
	Male	12.7±9.12	12.5 (0-25)	t:0.998	12.7±9.12	12.5 (0-25)	t:-0.078
Age	**18-23**	25.6±13.72	26.8 (5.4-46.4)	[c]***0.115***	20.04±19.02	25 (-16.1-46.4)	[c]***0.226***
	24-29	17.33±14.75	14.3 (0-46.4)	F:2.263	11.77±15.97	7.1 (-19.6-46.4)	F:1.536
	≥30	11.99±16.1	4.5 (0-48.2)		8.42±12.62	1.8 (-1.8-41.1)	
Marital status	**Married**	15.96±15.8	10.7 (0-48.2)	[b]***0.672***	6.58±13.77	3.6 (-16.1-32.1)	[b]***0.079***
	Single	17.96±15.33	14.3 (0-46.4)	t:-0.427	15.02±16.27	12.5 (-19.6-46.4)	t:-1.792
Education level	**Secondary Education - Assoc. Degree**	16.72±13.18	14.3 (0-33.9)	[b]***0.885***	12.18±15.13	8.9 (-16.1-32.1)	[b]***0.187***
	Undergraduate Degree	17.49±16.06	14.3 (0-48.2)	t:-0.145	12.36±16.27	7.1 (-19.6-46.4)	t:-1.340
Years in profession	**≤5 years**	20.97±15.11	21.4 (0-48.2)	[b]***0.006****	14.56±16.98	12.5 (-19.6-46.4)	[b]***0.973***
	≥6 years	4.38±7.11	0 (0-19.6)	t:-2.851	4.38±7.11	0 (0-19.6)	t:-0.034
Work Department	**Neurology ICU**	0±0	0 (0-0)	[c]***0.001****	0±0	0 (0-0)	[c]***0.001****
	Neurology Department	29.95±16.32	33.9 (0-48.2)	F:16.571	14.56±22.41	7.1 (-16.1-46.4)	F:3.676
	Emergency Department	17.03±11.51	14.3 (0-46.4)		15.24±13.13	14.3 (-19.6-46.4)	
Years in the unit	**Less than one year**	25.56±17.47	31.3 (0-46.4)	[b]***0.008****	16.18±21.74	16.1 (-16.1-46.4)	[b]***0.242***
	≥ one year	13.45±12.76	11.6 (0-48.2)	t:2.775	10.5±12.2	8 (-19.6-41.1)	t:1.185
Method of training received	**In-Service training**	9.5±10.22	6.3 (0-32.1)	[b]***0.001****	9.5±10.22	6.3 (0-32.1)	[b]***0.159***
	Distance training	27.27±15.17	30.4 (0-48.2)	t:-4.939	15.91±20.73	17 (-1.6-46.4)	t:-1.432
Feeling competent in TPA administration	**Yes**	11.4±12.7	7.1 (0-48.2)	[b]***0.001****	8.46±11.62	5.4 (-19.6-41.1)	[b]***0.011****
	No	29,91±12.89	32.1 (3,6-46.4)	t:-4.786	20.54±20.51	25.9 (-16.1-46.4)	t:-2.661

bStudent-t Test cOne Way ANOVA Test **p<0.01*p<0.05

Table 4. Comparison of Changes in State and Trait Anxiety Scale Pre-Test, Post-Test, and One-Month Post-Test Scores in Terms of Descriptive Characteristics

		State Anxiety Scale (Pre-Test – Post-Test)			State Anxiety Scale (Pre-Test – One Month Later Test)		
		Mean ± SD	Median (Min-Max)	*p / Test value*	Mean ± SD	Median (Min-Max)	*p / Test value*
Gender	**Female**	-10.78±6.67	-11(-30-6)	[a]***0.171***	-9.83±5.82	-11(-24--1)	[a]***0.058***
	Male	-7.11±9.28	-6(-18-10)	t:-1.390	-4.22±7.77	-5(-18-8)	t:-1.461
Age	**18-23**	-8.11±11.03	-6 (-30-10)	[b]***0.480***	-7.44±8.9	-9 (-19-8)	[b]***0.718***
	24-29	-11.22±5.7	-12 (-20-2)	F:0.745	-9.44±5.29	-11 (-18-0)	F:0.334
	≥30	-9.29±7.18	-9 (-20-6)		-8.5±7.24	-7.5(-24--1)	
Marital status	**Married**	-12.69±6.75	-13.5 (-30--4)	[a]**0.085**	-8.94±5.07	-9 (-19--2)	[a]**0.931**
	Single	-8.91±7.24	-11 (-20-10)	t:-1.757	-8.76±7.15	-10 (-24-8)	t:-0.087
Education level	**Secondary Education Associate Degree**	-6.73±11.09	-6 (-30-10)	[a]**0.078**	-7.73±8.86	-8 (-19-8)	[a]**0.533**
	Undergraduate Degree	-11.08±5.56	-12 (-20-2)	t:-1.800	-9.13±5.78	-9 (-24-0)	t:-0.627
Years in profession	**≤5 years**	-10.23±7.25	-11 (-30-10)	[a]**0.841**	-8.74±6.27	-9 (-19-8)	[a]**0.878**
	≥6 years	-9.73±7.54	-9 (-20-6)	t:-0.202	-9.09±7.58	-8 (-24--1)	t:0.155
Work Unit	**Neurology ICU**	-13.78±4.76	-15 (-20--4)	[b]**0.008****	-14.44±6.11	-16 (-24--3)	[b]**0.002****
	Neurology Department	-13.46±6.95	-13 (-30--3)	F=5.319	-10.23±5.66	-12 (-19--1)	F:7.096
	Emergency Department	-7.39±7.03	-6 (-18-10)		-6.36±5.8	-7 (-16-8)	
Years in unit	**Less than 1 year**	-12.31±8.65	-13.5 (-30-10)	[a]**0.143**	-9.38±7.02	-10.5 (-19-8)	[a]**0.683**
	≥1 year	-9.09±6.35	-9.5 (-20-6)	t:1.487	-8.56±6.34	-8.5 (-24-4)	t:0.411
Method of training received	**In-Department training**	-9.79±6.66	-11 (-20-6)	[a]**0.717**	-9.07±6.43	-8.5 (-24-0)	[a]**0.761**
	Distance education	-10.55±8.05	-11 (-30-10)	t:-0.365	-8.5±6.73	-9 (-19-8)	t:0.306
Feeling competent in TPA administration	**Yes**	-9.44±6.45	-10.5 (-20-6)	[a]**0.339**	-8.88±6.62	-8.5 (-24-4)	[a]**0.922**
	No.	-11.56±8.73	-12 (-30-10)	t:-0.966	-8.69±6.45	-10 (-19-8)	t:0.098

		Trait Anxiety Scale (Pre-Test – Post-Test)			Trait Anxiety Scale (Pre-Test – One Month Later Test)		
		Mean ± SD	Median (Min-Max)	*p / Test value*	Mean ± SD	Median (Min-Max)	*p / Test value*
Gender	**Female**	-13.93±7.61	-15(-28--1)	***0.008****	-12.83±5.79	-14(-22--2)	***0.001****
	Male	-5.89±8.91	-8(-20-11)	t:-2.785	-4.22±8.9	-6(-16-11)	t:-3.647
Age	**18-23**	-14.33±11.18	-17 (-24-11)	***0.704***	-11.56±8.52	-14 (-16-11)	***0.895***
	24-29	-12.48±7.35	-12 (-28-2)	F:0.354	-11.59±6.64	-10 (-22-7)	F:0.111
	≥30	-11.29±8.65	-10 (-24--1)		-10.5±7.75	-8.5 (-22--2)	
Marital status	**Married**	-16.56±8.05	-19.5 (-28--1)	**0.016***	-13.63±6.77	-14 (-22--2)	**0.114**
	Single	-10.56±7.91	-10.5 (-23-11)	t:-2.490	-10.18±7.18	-10.5 (-22-11)	t:-1.612
Education level	**Secondary Education Associate Degree**	-11.18±10.35	-11 (-24-11)	**0.565**	-11.18±7.92	-14 (-16-11)	**0.960**
	Undergraduate Degree	-12.85±7.84	-13 (-28-2)	t:0.579	-11.31±7.06	-10 (-22-7)	t:0.051
Years in profession	**≤5 years**	-12.59±8.58	-12 (-28-11)	**0.863**	-11.23±7.34	-13 (-22-11)	**0.928**
	≥6 years	-12.09±7.93	-15 (-24--1)	t:0.173	-11.45±6.89	-14 (-21--2)	t:-0.090
Work Unit	**Neurology ICU**	-17.11±3.48	-17 (-22--11)	**0.002****	-15.11±4.7	-16 (-22--8)	**0.002****
	Neurology Department	-16.85±8.51	-20 (-28--2)	F:7.001	-15.15±6.14	-14 (-22--4)	F:7.292
	Emergency Department	-8.96±7.88	-8 (-23-11)		-8.25±6.96	-8 (-19-11)	
Years in unit	**Less than 1 year**	-16.38±10.3	-20 (-28-11)	**0.022***	-13.63±8.35	-15 (-22-11)	**0.114**
	≥1 year	-10.65±6.7	-10.5 (-23-2)	t:-2.362	-10.18±6.38	-9.5 (-22-7)	t:-1.612
Method of training received	**In-Department training**	-11.61±7.2	-11.5 (-23-2)	**0.411**	-10.29±6.24	-9.5 (-22-7)	**0.273**
	Distance education	-13.59±9.71	-14 (-28-11)	t:0.830	-12.55±8.18	-14 (-22-11)	t:1.109
Feeling competent in TPA administration	**Yes**	-11.29±7.16	-11 (-24-2)	**0.146**	-10.44±6.66	-9,5 (-22-7)	**0.232**
	No.	-15±10.29	-18 (-28-11)	t:1.479	-13.06±8.09	-14 (-22-11)	t:1.211

bStudent-t Test cOne Way ANOVA Test **p<0.01*p<0.0

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DISCUSSION

This study examined the effect of training provided to nurses on tissue plasminogen activator administration for patients diagnosed with stroke on nurses' anxiety levels. The findings were interpreted at the level of association rather than causality, in accordance with the quasi-experimental, single-group design of the study.

The sociodemographic characteristics of the nurses included in this study were generally consistent with those reported in previous studies conducted in similar clinical settings (11–13). Most participants had previously received training on TPA administration, primarily through in-service education programs. Notably, nurses who received distance (online) training during the pandemic demonstrated greater increases in knowledge scores, suggesting that flexible and accessible educational formats may be effective under challenging conditions.

Several studies have reported inadequate knowledge and practice levels among nurses regarding thrombolytic therapy administration, despite prior training experiences (14–16). Factors contributing to this inadequacy include insufficient in-service training, limited clinical supervision, high workload, and staffing shortages. In line with the literature, the present study found that structured training was associated with significant improvements in nurses' knowledge levels related to TPA administration (17,18). Although the study did not include a control group, the magnitude and persistence of within-group changes—particularly the ceiling-level improvement in knowledge scores and the sustained reduction in anxiety levels—suggest that the training had a meaningful practical impact.

Nurses who were newly employed or had shorter tenure in their units demonstrated greater reductions in anxiety scores following the training. This finding may be explained by the higher educational needs and lower baseline confidence levels among less experienced nurses. Previous studies have shown that newly graduated or less experienced nurses often experience increased anxiety due to limited clinical exposure and perceived inadequacy in patient care skills (19). Regular and repeated training programs may help mitigate these concerns by reinforcing both theoretical knowledge and practical competence (20). Differences in anxiety score changes were also observed according to the clinical unit in which nurses worked. Nurses employed in neurology and neurology intensive care units demonstrated greater reductions in both state and trait anxiety levels compared to those working in emergency departments. This may be attributed to differences in patient flow, workload intensity, and the clinical environment. Emergency departments are characterized by high patient turnover, time pressure, and frequent exposure to acute and unpredictable cases, all of which may contribute to sustained anxiety among nursing staff.

Nurses reported experiencing anxiety related to concerns about making errors in TPA administration, particularly in clinical settings that were perceived as less suitable for close monitoring and follow-up. Similar findings have been reported in previous studies, which identified high workload, insufficient staffing, and fear of medication errors as major sources of anxiety among nurses (21,22).

Overall, the findings of this study support the view that improving nurses' knowledge through structured educational interventions may contribute to reduced anxiety and enhanced confidence in clinical practice. However, these findings should be interpreted cautiously due to the methodological limitations of the study.

CONCLUSION

This study demonstrated that training provided to nurses on the administration of tissue plasminogen activator for patients diagnosed with stroke was associated with increased knowledge levels and decreased anxiety levels among nurses. The findings suggest that structured and guideline-based TPA training programs may support nurses' professional preparedness and psychological well-being in stroke care settings.

Given the single-group, quasi-experimental design of the study, the results should be interpreted as indicative of an association rather than a causal relationship. Nevertheless, the observed improvements highlight the potential value of regular and targeted training programs in clinical practice.

Recommendations

Given the relatively small sample size of this study, future research should be conducted with larger and more diverse samples to enhance the generalizability of the findings. In addition, the continuity and sustained effectiveness of training programs should be emphasized. Accordingly, it is recommended that nurses' knowledge and skills related to TPA administration be regularly updated through structured in-service training programs that are implemented on a periodic basis.

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None.

Conflicts of Interest

None of the authors have any conflict of interest or financial ties to disclose.

Ethical Considerations

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and/or with the Helsinki Declaration of 1964 and later versions.

Authors' Contribution

Conceptualization: EA
Data curation: EA, BB
Formal analysis: EA, BB
Funding Acquisition: -
Investigation: EA, BB
Methodology: EA, BB
Statistics: EA, BB
Project administration: EA
Supervision: EA
Validation: EA, BB
Visualization: EA, BB
Writing–original draft: EA
Writing–review & editing: EA

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