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# The effect of online training based on stroke educational program on patient's quality of life and caregiver's care burden: a randomized controlled trial

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## Abstract

**Background** Stroke is considered one of the leading causes of both mortality and morbidity on a global scale. The significant impact on the health and quality of life of stroke survivors and their caregivers is well-acknowledged due to the stressful consequences of dependency and the need for home care. This study aims to examine the impact of online training utilizing a stroke educational program on the patient's quality of life and their caregivers' care burden.

**Materials and methods** From March to August 2024, a randomized, controlled trial was conducted. In this study, a total of 60 dyads consisting of stroke patients and their caregivers participated. Participants were selected by convenient sampling method and then randomly allocated into intervention and control groups using research randomizer software. The participants in the intervention group received the educational content through the WhatsApp application during a series of fifteen sessions, each lasting between 45 and 60 min. The control group was given standard hospital education. The data collection and analysis process entailed the utilization of questionnaires, which encompassed demographics, the Stroke Specific Quality of Life Scale (SS-QOL), and the Zarit burden of care questionnaires.

**Results** In the intervention group, the average age of patients and caregivers was  $60.23 \pm 12.41$  and  $51.56 \pm 10.42$ , respectively, while in the control group, it was  $61.73 \pm 12.61$  and  $53.60 \pm 9.03$ , respectively. The intervention group demonstrated a statistically significant difference in the mean score of patient's quality of life, comparing the baseline with the post-intervention periods ( $134.73 \pm 33.51$  vs.  $90.56 \pm 6.51$  and  $130.46 \pm 30.67$  vs.  $90.56 \pm 6.51$ ;  $p < 0.05$ ). Furthermore, a statistically significant difference in the mean score of caregiver's care burden was noted between the baseline and post-intervention periods ( $80.23 \pm 7.99$  vs.  $65.43 \pm 16.52$  and  $80.23 \pm 7.99$  vs.  $60.53 \pm 21.34$ ;  $p < 0.05$ ).

**Conclusion** The implementation of an online training program focused on stroke education, resulted in an improvement in the quality of life for stroke patients, as well as a reduction in the care burden for their caregivers. As a result, it is essential to provide education to patients and their caregivers to improve patient care and minimize stroke complications.

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**Keywords** Educational program, Caregiver burden, Quality of life, Stroke

## Background

The occurrence of vascular stroke presents a significant public health concern on a national and global scale, resulting in high levels of morbidity, mortality, and recurrent episodes [1]. High-income countries have successfully experienced a significant reduction in the occurrence, death rate, and disability burden caused by strokes over the past decades. This achievement can largely be attributed to advancements in primary and secondary prevention methods as well as improvements in acute stroke treatment and neurorehabilitation [2]. Nevertheless, stroke remains the predominant factor contributing to long-term disability, with stroke patients representing the highest proportion of healthcare service users [3]. As life expectancy continues to rise in developed nations, leading to a shift in age distribution, stroke remains a prominent issue with significant ramifications for healthcare and social systems across the globe [4, 5].

The burdens resulting from a stroke impact patients in multiple ways, including physically, psychologically, socially, and economically [6–8]. The impact of stroke on a person's life quality and social connections has been largely ignored, despite the significant advancements in stroke treatment. The devastating impact of stroke on a person's quality of life has been demonstrated by Salari-mehr et al. [9] and Laurent et al. [10].

The care of stroke survivors encompasses a multifaceted range of activities, with the goals being subject to continuous modification and adaptation to suit the specific requirements of each patient [5]. Following their hospital discharge, most stroke survivors rely on their families, typically their spouses, for vital rehabilitation, care, and emotional support. The family serves as the informal caregiver, as family members undertake the responsibility of caring for their relatives, incurring significant costs themselves. This represents a valuable resource for the healthcare system and society [11].

The demands of home care significantly impact the health and quality of life of caregivers [12]. Caregivers frequently experience a sense of unpreparedness for their new responsibilities, which can lead to distress and detrimental effects on their physical, mental, and social well-being. These adverse consequences of caregiving are often characterized as burden, tension, and stress [13, 14].

The term “caregiver burden” encompasses the adverse emotional and tense feelings that caregivers experience while caring for patients with stroke or other chronic ailments [15]. The care experience yields a negative outcome, worsened by the caregiver's numerous roles and

responsibilities [16]. Changing life conditions following a stroke leaves the family with little time to adapt to the role of the caregiver, causing high levels of anxiety and depression that adversely affect the caregiver's health [17].

Caregivers' health is linked to the patient's physical, mental, psychological, and functional conditions. Caregivers may suffer from burden, depression, exhaustion, or general bad health depending on the level of dependency of the patient [12]. Higher levels of caregiving stress are associated with caregivers reporting worse physical health, whereas those with lower burdens tend to report a higher quality of life [18].

Stroke patients and their caregivers have unmet needs ranging from health-related and informational needs to reintegration into the community. Meeting these needs can improve patient education and possibly their outcomes [19, 20]. The efficacy of education programs on the quality of life and care burden of family caregivers of stroke patients has been demonstrated in several studies [21–23]. Nevertheless, the present study investigated the effectiveness of dyadic interventions on stroke patient-caregiver dyads' outcomes based on the results of a systematic review and meta-analysis, which indicated that dyadic psychoeducational intervention significantly reduced family caregivers' burden and improved quality of life for stroke patients [24]. According to the literature review, despite high stroke prevalence and the need to address the educational needs of patients and their caregivers, there are few studies similar to the present study. Therefore, conducting such studies is crucial for securing evidence and solidifying our knowledge base in this field. This study aims to investigate the effect of online training based on an educational program on stroke patient's quality of life and caregiver's care burden.

## Methods

### Trial design

Between March 1 and July 31, 2024, a randomized clinical trial with a pre-and post-test design was conducted to evaluate the effectiveness of an online educational program. The primary outcomes measured were the improvement in the patient's quality of life and the reduction of the caregiver's care burden. Following a thorough review in accordance with the Declaration of Helsinki by the World Medical Association [25], the study protocol received approval from the Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran. To ensure compliance with the recommended standards, this study was conducted and the findings were reported

following the guidelines outlined in the Consolidated Standards of Reporting Trials (CONSORT) statement [26].

### Setting and participants

The participants included stroke patients and their caregivers referring to specific hospitals affiliated with Shahid Beheshti University of Medical Sciences (Ayatollah Taleghani, Shohadaye Tajrish, Imam Hossein, and Luqman Hakim) as well as the Tabassom Stroke Rehabilitation Clinic in Tehran, Iran. The inclusion criteria for patients were: (1) Being 18 years old and over (2) Having a confirmed diagnosis of stroke by a neurologist (3) Being discharged from acute hospital settings to home (4) Having enough awareness to communicate (5) Having the ability to read and write (6) Having a smartphone. Furthermore, the inclusion criteria for caregivers were: (1) Being the primary caregiver of a family member with a confirmed diagnosis of stroke (2) Having the ability to read and write (3) Having a smartphone. The exclusion criteria for patients and their caregivers were: (1) Participation in another educational program during the research (2) Deterioration of the patient's physical and mental condition during the study so that it is not possible to continue participating in the study (3) disconnection and lack of access to the person during the study (4) Failure to complete or incomplete completion of questionnaires.

### Sample size

The minimum sample size was determined based on similar studies [23, 27] and the following formula:

$$n \geq 2 \frac{(z_{\frac{\alpha}{2}} + z_{\beta})^2 \delta^2}{(\mu_1 - \mu_2)^2}$$

$$\alpha = 0.05 \Rightarrow Z_{\frac{\alpha}{2}} = 1.96$$

$$\beta = 0.10 \Rightarrow Z_{\beta} = 1.28$$

$$(\mu_1 - \mu_2) / \delta = 0.60$$

$$n = 2(1.96 + 1.28)^2 \left( \frac{1}{0.60} \right)^2 = 59$$

Considering a 10% drop-out rate, the desired sample size was determined as 64 samples in each group.

### Randomization

The convenience sampling method was used to initially select the eligible participants. Then, an independent research assistant who was not involved in the selection

of samples used Research Randomizer Software to prepare a list of random numbers corresponding to the sample size [28]. During the randomization process, patients were assigned to either the intervention or control group in a 1:1 ratio, and no additional stratification was implemented. To avoid bias, the randomization list was concealed from all individuals who were responsible for informing potential study participants. The numbers were printed separately and each was sealed in an envelope so that only the research assistant knew the information inside each envelope. Then the researcher opened the envelopes and the eligible participants were randomly assigned to one of the intervention or control groups.

### Measures

#### The demographic questionnaire

This questionnaire was prepared based on a literature review and experts' opinions and included age, gender, marital status, level of education, employment status, and monthly income.

#### Stroke specific quality of life scale (SS-QOL)

The Stroke Specific Quality of Life Scale developed by William et al. (1999) comprises 12 dimensions and 49 items, measured on a 5-point Likert scale. Scores range from 49 to 245, with higher scores signifying an elevated quality of life. The questionnaire consists of multiple dimensions, including work/productivity (3 items), vision (3 items), upper extremity function (5 items), thinking (3 items), social roles (5 items), self-care (5 items), personality (3 items), mood (5 items), mobility (6 items), language (5 items), energy (3 items), and family roles (3 items). In the survey, participants were given a range of options to choose from when responding to the items. These options ranged from "strongly disagree" to "strongly agree" and covered various areas such as social roles, personality, mood, family roles, and energy. In terms of work/productivity, language, vision, upper extremity function, thinking, and mobility, the response range varies from "couldn't do it at all" to "no trouble at all." Also, the self-care scale offered a range of options, from "total help" to "no help needed." The original questionnaire's validity and reliability were evaluated in William et al.'s study and it was found that the questionnaire's dimensions had a reliability coefficient of over 0.75 [29]. In Iran, Azimi et al. conducted a survey to evaluate the validity and reliability of this questionnaire. The reliability was assessed using Cronbach's alpha coefficient method, which yielded a value of 0.95 [30]. The present study used Alpha Cronbach to assess the reliability of the subscales of the SS-QoL questionnaire, including energy, family roles, mood, personality, social roles, mobility, thinking, upper extremity function, vision, work/productivity, language, and self-care, resulting in reliability scores of 0.85,

0.79, 0.83, 0.82, 0.75, 0.77, 0.76, 0.75, 0.81, 0.83, 0.78, and 0.84, respectively. Additionally, the questionnaire's overall reliability was confirmed by its Cronbach's alpha coefficient, which was found to be 0.80.

### Zarit burden interview

The Zarit Burden Interview (ZBI) was created in 1980 to evaluate the extent of the caregiving burden. The tool comprised 22 items that specifically addressed the burden experienced by caregivers in their patient care responsibilities. The Likert scale consists of five points and includes responses ranging from never (score 0) to always (score 4). Within this tool, individuals will have a range of scores from 0 to 88, where a higher score signifies a greater level of care burden. A care burden is considered weak if the score is less than 30, moderate if it falls between 31 and 60, and severe if it ranges from 61 to 88 [31]. Mirhosseini and colleagues evaluated the Persian version of ZBI's validity and reliability using internal consistency analysis, which yielded a Cronbach's  $\alpha$  coefficient of 0.90 [32]. Based on Cronbach's alpha calculation, the present study obtained a 0.92 reliability rating for this questionnaire.

### Implementation

After acquiring the necessary permits, all participants provided informed consent, indicating their voluntary participation in the study. The allocation of sampling was achieved via the utilization of Research Randomizer Software, leading to the division of participants into two intervention and control groups. Within each group, there were 32 patients and 32 caregivers. At the beginning of the study patients and their caregivers in both intervention and control groups completed the

demographic questionnaire, Stroke Specific Quality of Life Scale, and Zarit care burden scale.

Participants in the intervention group received educational materials specifically designed for stroke education, based on Kern's model. It consists of six steps: needs assessment, initial design, goals and specific objectives, educational strategy, program implementation, and program evaluation [33]. First, we examine patients' and caregivers' educational needs using the nominal group technique [34] and literature review. The next step consisted of formulating general and specific goals of the program based on the results of the previous steps, and providing them to ten faculty members at the Shahid Beheshti University of Medical Sciences for their input. Afterward, the program's education strategies were also developed. The research developed appropriate educational content and methods based on the results of the problem identification, needs assessment, and types of educational goals obtained. Then, a draft of the comprehensive educational program was provided to the faculty members. The educational content of this program was validated by faculty members after it was revised to include expert opinions and the necessary changes.

To implement the educational program, the first author, under the supervision of expert professors, put in meticulous effort to prepare the educational content. This content was subsequently shared with the participants using the WhatsApp application. After installing and training on how to use the WhatsApp application, a WhatsApp group was formed for the participants in the intervention group, and educational content was presented to them in the form of PowerPoint and educational audio and videos. The user group for each provided educational content was categorized as being specifically for patients or their caregivers. Additionally, in certain instances, participants were requested to take on the role of educators and teach one another. For the participants in the intervention group, 15 educational sessions were held over 45 days. Each session lasted 45–60 min. To guarantee that the participants in the intervention group received the essential training and had their queries resolved, they were contacted via phone on a weekly basis.

The educational topics presented were definition of stroke and its epidemiology; risk factors and prevention of stroke; symptoms and complications of stroke; care measures in ischemic and hemorrhagic stroke; common and ongoing stroke drugs; supplies and equipment used in stroke rehabilitation; care of the eyes; urinary catheter care; nutritional care; prevention of pressure ulcers; activity, physical therapy, and range of motion exercises; controlling the emotions and stress of stroke patients and their caregivers; counseling and emotional support of stroke patients and their caregivers; education and follow-up after hospital discharge; and stroke supporting organizations. The educational content of the

**Table 1** The educational content of the sessions

Session 1	Definition of stroke and its epidemiology
Session 2	Risk factors and prevention of stroke
Session 3	Symptoms and complications of stroke
Session 4	Care measures in ischemic and hemorrhagic stroke
Session 5	Common and ongoing stroke drugs
Session 6	Supplies and equipment used in stroke rehabilitation
Session 7	Care of the eyes in stroke patients
Session 8	Urinary catheter care in stroke patients
Session 9	Nutritional care in stroke patients
Session 10	Prevention of pressure ulcers in stroke patients
Session 11	Activity, physical therapy and range of motion exercises in stroke patients
Session 12	Controlling the emotions and stress of stroke patients and their caregivers
Session 13	Counseling and emotional support of stroke patients and their caregivers
Session 14	Education and follow-up after hospital discharge
Session 15	Stroke Supporting organizations

sessions is summarized in Table 1. Standard hospital education, provided by nurses, was given to the participants in the control group. Two months following the completion of the educational intervention, another research assistant, who had no involvement in the allocation process and training of participants, collected questionnaires through in-person interactions with prior arrangements. Also, to enhance participant accessibility and ensure efficient data collection, the questionnaires were developed in the form of an electronic link and then sent to the participants who were unable to participate in person or did not have adequate time to complete the questionnaires. At the end of the study to comply with ethical principles, the educational content of the held sessions was prepared in the form of a booklet and provided to all participants.

**Data analysis**

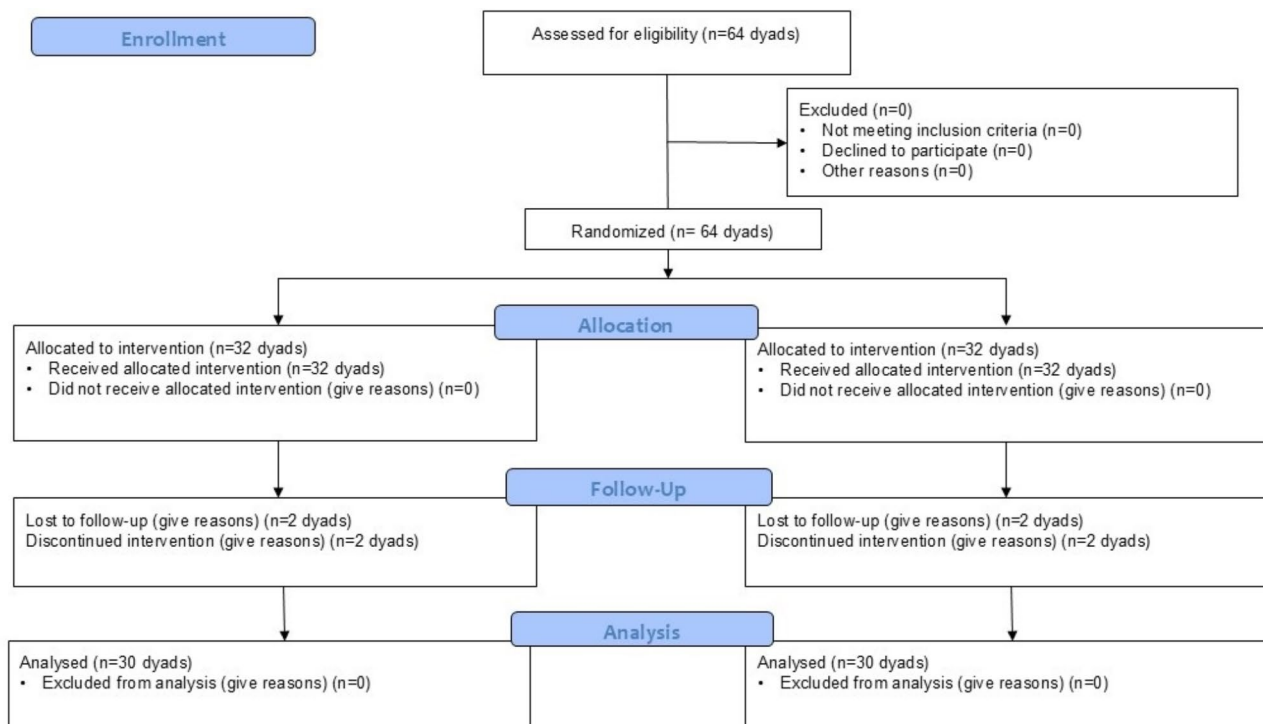
To compare the demographic characteristics of participants between groups, the independent t-test was used for quantitative variables, while the Chi-squared test and Fisher’s exact test were employed for qualitative variables.

The study primarily aimed to analyze data concerning the patient’s quality of life and the caregivers’ care burden. Statistical tests including the independent t-test (for between-group comparisons), single repeated measurements ANOVA (for within-group comparisons), and overall repeated measurements ANOVA (to examine the effects of time, group, and time\*group interaction) were employed for examination.

Moreover, Bonferroni’s post hoc test was utilized to conduct pairwise comparisons among different periods. In order to determine the effect size, we utilized Cohen’s d for the independent t-test and Eta squared ( $\eta^2$ ) for the repeated measures ANOVA. Based on the established guidelines, it is determined that for Cohen’s d, an effect size of 0.2 is classified as small, 0.5 as medium, and 0.8 as large effects. Similarly, for Eta squared, an effect size of 0.01 is categorized as small, 0.06 as medium, and 0.14 as large effects [35, 36]. In Fig. 1 the CONSORT flow diagram of the participants is presented.

**Ethical considerations**

In accordance with ethical considerations, the ethical committee at Shahid Beheshti University of Medical Sciences has approved this study (IR.SBMU.PHARMACY.REC.1402.178). Also, this randomized clinical trial study was registered in the Iranian Registry of Clinical Trials, on August 31, 2024, with the code IRCT20240609062065N1. A comprehensive explanation of the study’s objectives and methodology was then provided to the head nurses and nurses working in the neurology wards. The confidentiality of participants’ names and information was guaranteed. Furthermore, the participants were informed that their participation in the study was voluntary and that they had the option to withdraw at any time. All participants were required to provide written informed consent before participating in the study. Moreover, following the completion of data



**Fig. 1** Consort flow diagram of the participants

**Table 2** Patients' socio-demographic characteristics at baseline (N=60)

Participants	Characteristics	Groups		P-value
		Intervention (N=30)	Control (N=30)	
Patients (N=60)	<b>Age</b> (year), Mean ± SD	60.23 ± 12.41	61.73 ± 12.61	0.644*
	<b>Gender</b> , N (%)			
	Male	16 (53.3%)	13 (43.3%)	0.438#
	Female	14 (46.7%)	17 (56.7%)	
	<b>Marital status</b> , N (%)			
	Single	4 (13.3%)	6 (20%)	0.488#
	Married	26 (86.7%)	24 (80%)	
	<b>Education</b> , N (%)			
	High school	15 (50%)	17 (56.7%)	0.482¶
	Diploma	12 (40%)	8 (26.7%)	
	College Education	3 (10%)	5 (16.6%)	
	<b>Occupation</b> , N (%)			
	Unemployed	6 (20%)	5 (16.7%)	0.903¶
	Employed	9 (30%)	8 (26.7%)	
	Housewife	10 (33.3%)	12 (43.3%)	
	Retired	5 (16.7%)	4 (13.3%)	
<b>Income</b> (month), N (%)				
Weak	20 (66.7%)	22 (73.3%)	0.773¶	
Moderate	5 (16.7%)	6 (20%)		
Good	4 (13.3%)	2 (6.7%)		
Excellent	1 (3.3%)	0 (0%)		

Abbreviations: SD: Standard deviation; \*: Independent samples t-test; #: Chi-squared test; ¶: Fisher's exact test

collection, the control group was given instructions on how to effectively care for stroke patients.

### Results

According to the results, the average age of patients in the intervention and control groups was 60.23 ± 12.41 and 61.73 ± 12.61, respectively. A majority of the patients in the intervention group (53.3%) were male, whereas most of those in the control group (56.7%) were female. It was also found that the intervention and control groups were similar in terms of demographics, with 86.7% of married participants compared to 80%,  $p = 0.488$ , 33.3% housewives compared to 43.3%,  $p = 0.903$ , and those with a high level of education (50% vs. 56.7%,  $p = 0.482$ ) and a weak level of income (66.7% vs. 73.3%,  $p = 0.773$ ) (Table 2).

The average age of caregivers in the intervention and control groups was 51.56 ± 10.42 and 53.60 ± 9.03, respectively. Also, the patient care history of caregivers in the intervention and control groups was 3.76 ± 2.04 and 3.20 ± 1.83, respectively. It was found that a significant proportion of caregivers were married (80% vs. 83.3%,

**Table 3** Caregivers' socio-demographic characteristics at baseline (N=60)

Participants	Characteristics	Groups		P value
		Intervention (N=30)	Control (N=30)	
Caregivers (N=60)	<b>Age</b> (year), Mean ± SD	51.56 ± 10.42	53.60 ± 9.03	0.423*
	<b>Patient care history</b> , Mean ± SD	3.76 ± 2.04	3.20 ± 1.83	0.262*
	<b>Gender</b> , N (%)			
	Male	13 (43.3%)	14 (46.7%)	0.795#
	Female	17 (56.7%)	16 (53.3%)	
	<b>Marital status</b> , N (%)			
	Single	6 (20%)	5 (16.7%)	0.739#
	Married	24 (80%)	25 (83.3%)	
	<b>Education</b> , N (%)			
	High school	6 (20%)	7 (23.3%)	0.949#
	Diploma	6 (20%)	6 (20%)	
	academic education	18 (60%)	17 (56.7%)	
	<b>Employment</b> , N (%)			
	Unemployed	5 (16.7%)	4 (13.3%)	0.753¶
	Employed	10 (33.3%)	14 (46.7%)	
	Housewife	12 (40%)	9 (30%)	
Retired	3 (10%)	3 (10%)		
<b>Income</b> (month), N (%)				
Weak	13 (43.3%)	12 (40%)	0.959#	
Moderate	11 (36.7%)	12 (40%)		
Good	6 (20%)	6 (20%)		

Abbreviations: SD: Standard deviation; \*: Independent samples t-test; #: Chi-squared test; ¶: Fisher's exact test

$p = 0.739$ ), and had an academic level of education (60% vs. 56.7%,  $p = 0.949$ ). As for employment status, most participants in the intervention group were housewives, while most participants in the control group were employed (40% vs. 46.7%,  $p = 0.753$ ). In addition, the intervention group is predominantly composed of weak-income individuals, whereas the control group is mostly composed of moderate-to-high level of income individuals (43.3 vs. 40,  $p = 0.959$ ) (Table 3).

At baseline, there was not a significant difference in patients' quality of life scores between the two groups ( $p = 0.945$ ). However, there was a significant difference between the intervention and control groups in mean quality of life scores immediately after the intervention (Cohen's  $d = 1.22$ ,  $p < 0.001$ ) and two months afterward (Cohen's  $d = 1.084$ ,  $p < 0.001$ ) (between-group difference). Moreover, the intervention group exhibited a significant improvement in quality of life from baseline to two months of follow-up ( $\eta^2 = 0.600$ ,  $p < 0.001$ ) (within-group

difference). Nevertheless, the control group did not show a significant difference ( $p=0.740$ ) (Table 4).

In the intervention group, the mean score of different dimensions of the SS-QOL questionnaire was significantly improved immediately after the intervention and two months after the intervention when compared to the control group (Table 5).

Based on baseline data, there was no significant difference in caregivers' care burdens between the two groups ( $p=0.963$ ). However, After the intervention, there was a significant difference in the mean score of care burden between the intervention group and the control group (Cohen's  $d=0.695$ ,  $p=0.009$ ) and two months later (Cohen's  $d=0.767$ ,  $p=0.004$ ) (between-group difference). Furthermore, the intervention group demonstrated a significant reduction in care burden from baseline to two months after the intervention ( $\eta^2=0.600$ ,  $p<0.001$ ) (within-group difference). However, this difference was not significant in the control group ( $p=0.740$ ) (Table 6).

### Discussion

The primary goal of this study was to examine the impact of an online training program that focuses on stroke education on both the quality of life of patients and the level of burden experienced by their caregivers. The results of this study indicated that the educational program had a significant effect on enhancing the overall quality of life score, providing further support for the first hypothesis of the research. In the post-intervention periods, the intervention group experienced a significant improvement in the mean score of patients' quality of life compared to the control group. The scores demonstrated a strong and clinically significant effect size during these specific periods [37].

Also, the findings from the current study revealed that the implementation of this educational intervention had a significant impact on all aspects of SS-QOL in the intervention group compared to the control group. Immediately after the intervention, this effect was particularly significant in various areas, including vision, upper extremity function, self-care, social roles, mood, and personality. Nonetheless, the results showed a particularly

significant difference in various aspects, such as upper extremity function, energy levels, vision, self-care capabilities, social roles, and personality two months after the intervention.

Our study results are in line with the results obtained from the following studies. In their study, Urcan et al. demonstrated a significant impact of an education program on improving stroke patients' quality of life. The researchers found that this improvement was evident across all domains of the SS-QOL questionnaire [38]. Other studies stated that following the implementation of an education program, the mean score of SS-QOL was significantly higher in the intervention group than in the control group. Scores increased for both the Physical Component Summary (PCS) and the Mental Component Summary (MCS) [39, 40]. The results of Abolfathi et al.'s study also revealed that the implementation of an educational program can result in an enhanced quality of life among patients with stroke [37]. Additionally, in their study, Guillaumier et al. found that following the implementation of an online educational intervention the median score of Health-Related Quality of Life (HRQoL) was higher in the intervention group than the control group at the 6-month follow-up [41]. The inconsistency observed in the affected dimensions of quality-of-life measures can be attributed to several factors, including the varying levels of patient care, the patient's educational needs, and the availability of post-discharge follow-up programs.

In addition to confirming the second hypothesis of the present study, the results indicated that the educational program had a positive impact on reducing the mean score of caregivers' care burden. During the post-intervention periods, the mean score of caregivers' care burden showed a significant reduction in the intervention group as compared to the control group. Moreover, the scores demonstrated a moderate and clinically significant effect size during these specific periods. The findings from this study were in line with the results obtained from previous research studies. In their study, Hekmatpou et al. found that the implementation of an educational intervention resulted in a significant decrease in the average score of caregiver burden for the intervention

**Table 4** Between-group and within-group comparison of the mean score of the patients' quality of life

Variables	Groups	At baseline Mean ± SD	Immediately after the intervention Mean ± SD	2 months after the intervention Mean ± SD	Repeated measurement ANOVA			
					Single <sup>¶</sup> ( $P$ -value, $\eta^2$ )	Overall ( $P$ -value, $\eta^2$ )	Time	Group
SS-QOL	Experimental	90.56 ± 6.51	134.73 ± 33.51 <sup>A</sup>	130.46 ± 30.67 <sup>A</sup>	$P < 0.001$ , $\eta^2 = 0.600$	$P < 0.001$	$P < 0.001$	$P < 0.001$
	Control	90.73 ± 11.44	95.20 ± 31.13	92.13 ± 39.51				
	Test* ( $P$ -value, Cohen's $d$ )	$P = 0.945$	$P < 0.001$ , $d = 1.22$	$P < 0.001$ , $d = 1.084$				

Abbreviations: SD: Standard deviation; ANOVA: Analysis of variance;  $\eta^2$ : Eta squared (effect size); A: Significant difference with first-time point (at baseline). \*: Independent samples t-test (between-group comparison); ¶: Within-group comparison

**Table 5** Between-group and within-group comparison of the mean score of the patient's quality of life sub-scales

Variables	Groups	At baseline Mean ± SD	Immediately after the intervention Mean ± SD	2 months after the intervention Mean ± SD	Repeated measurement ANOVA			
					Single <sup>a</sup> (P-value, η <sup>2</sup> )	Overall (P-value, η <sup>2</sup> )	Time	Group
Energy	Experimental	5.20 ± 1.78	7.66 ± 2.56 <sup>A</sup>	7.43 ± 2.38 <sup>A</sup>	P = 0.001, η <sup>2</sup> = 0.374	P = 0.001 η <sup>2</sup> = 0.110	P < 0.001 η <sup>2</sup> = 0.192	P = 0.004 η <sup>2</sup> = 0.092
	Control	5.43 ± 1.56	6.03 ± 3.03	4.93 ± 1.92				
	Test* (P-value, Cohen's d)	P = 0.593	P = 0.028, d = 0.581	P < 0.001, d = 1.152				
Family roles	Experimental	4.76 ± 1.19	8.23 ± 3.26 <sup>A</sup>	7.86 ± 2.82 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.449	P < 0.001 η <sup>2</sup> = 0.196	P = 0.006 η <sup>2</sup> = 0.121	P < 0.001 η <sup>2</sup> = 0.135
	Control	5.50 ± 1.61	6.06 ± 2.66	5.60 ± 2.58				
	Test* (P-value, Cohen's d)	P = 0.051	P = 0.007, d = 0.727	P = 0.002, d = 0.838				
Mood	Experimental	8.73 ± 1.99	13.66 ± 4.57 <sup>A</sup>	12.30 ± 4.16 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.373	P < 0.001 η <sup>2</sup> = 0.154	P < 0.001 η <sup>2</sup> = 0.196	P = 0.002 η <sup>2</sup> = 0.101
	Control	8.90 ± 2.66	9.43 ± 3.70	9.46 ± 4.09				
	Test* (P-value, Cohen's d)	P = 0.785	P < 0.001, d = 1.017	P = 0.010, d = 0.686				
Personality	Experimental	5.23 ± 1.30	7.93 ± 2.69 <sup>A</sup>	7.93 ± 2.69 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.507	P = 0.005 η <sup>2</sup> = 0.127	P = 0.008 η <sup>2</sup> = 0.116	P < 0.001 η <sup>2</sup> = 0.192
	Control	5.83 ± 2.35	5.50 ± 2.77	5.50 ± 2.77				
	Test* (P-value, Cohen's d)	P = 0.226	P = 0.001, d = 0.890	P = 0.001, d = 0.890				
Social roles	Experimental	9.30 ± 1.55	14.20 ± 3.44 <sup>A</sup>	13.26 ± 3.11 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.551	P < 0.001 η <sup>2</sup> = 0.197	P < 0.001 η <sup>2</sup> = 0.283	P < 0.001 η <sup>2</sup> = 0.118
	Control	9.13 ± 2.06	9.83 ± 4.25	9.80 ± 4.39				
	Test* (P-value, Cohen's d)	P = 0.725	P < 0.001, d = 1.128	P < 0.001, d = 0.909				
Mobility	Experimental	11.26 ± 1.79	15.93 ± 4.77 <sup>A</sup>	15.60 ± 4.53 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.413	P < 0.001 η <sup>2</sup> = 0.127	P = 0.005 η <sup>2</sup> = 0.126	P = 0.001 η <sup>2</sup> = 0.107
	Control	11.90 ± 2.77	12.10 ± 4.32	12.13 ± 5.76				
	Test* (P-value, Cohen's d)	P = 0.298	P = 0.002, d = 0.842	P = 0.012, d = 0.669				
Thinking	Experimental	5.83 ± 1.26	8.43 ± 3.50 <sup>A</sup>	8.06 ± 3.27 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.294	P < 0.001 η <sup>2</sup> = 0.113	P = 0.002 η <sup>2</sup> = 0.151	P = 0.003 η <sup>2</sup> = 0.093
	Control	5.80 ± 1.54	5.87 ± 2.16	6.03 ± 2.67				
	Test* (P-value, Cohen's d)	P = 0.927	P = 0.001, d = 0.882	P = 0.011, d = 0.680				
Upper extremity function	Experimental	9.56 ± 1.97	14.33 ± 4.88 <sup>A</sup>	14.16 ± 4.93 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.441	P < 0.001 η <sup>2</sup> = 0.158	P < 0.001 η <sup>2</sup> = 0.340	P < 0.001 η <sup>2</sup> = 0.124
	Control	8.63 ± 2.15	9.13 ± 3.96	8.76 ± 4.29				
	Test* (P-value, Cohen's d)	P = 0.086	P < 0.001, d = 1.169	P < 0.001, d = 1.167				
Vision	Experimental	5.86 ± 1.13	9.03 ± 2.29 <sup>A</sup>	8.87 ± 2.47 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.587	P < 0.001 η <sup>2</sup> = 0.191	P < 0.001 η <sup>2</sup> = 0.360	P < 0.001 η <sup>2</sup> = 0.132
	Control	5.50 ± 1.33	5.93 ± 2.43	5.73 ± 3.18				
	Test* (P-value, Cohen's d)	P = 0.256	P < 0.001, d = 1.310	P < 0.001, d = 1.099				
Work/Productivity	Experimental	5.60 ± 1.75	7.90 ± 3.36 <sup>A</sup>	7.90 ± 3.36 <sup>A</sup>	P = 0.004, η <sup>2</sup> = 0.251	P = 0.002 η <sup>2</sup> = 0.103	P = 0.011 η <sup>2</sup> = 0.107	P = 0.040 η <sup>2</sup> = 0.054
	Control	5.56 ± 1.13	6.03 ± 3.03	5.90 ± 2.75				
	Test* (P-value, Cohen's d)	P = 0.931	P = 0.028, d = 0.582	P = 0.015, d = 0.650				



**Table 5** (continued)

Variables	Groups	At baseline Mean ± SD	Immediately after the intervention Mean ± SD	2 months after the intervention Mean ± SD	Repeated measurement ANOVA			
					Single <sup>¶</sup> (P-value, η <sup>2</sup> )	Overall (P-value, η <sup>2</sup> )	Time × Group	
Language	Experimental	9.40 ± 1.35	12.90 ± 4.28 <sup>A</sup>	12.83 ± 4.33 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.365 P = 0.698	P = 0.005 η <sup>2</sup> = 0.087	P < 0.001 η <sup>2</sup> = 0.197	P = 0.004 η <sup>2</sup> = 0.092
	Control	9.33 ± 2.05	9.63 ± 4.24	8.90 ± 4.42				
	Test* (P-value, Cohen's d)	P = 0.883	P = 0.004, d = 0.766	P < 0.001, d = 0.898				
Self-care	Experimental	9.80 ± 2.04	14.50 ± 4.13 <sup>A</sup>	14.23 ± 4.22 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.464 P = 0.926	P < 0.001 η <sup>2</sup> = 0.133	P < 0.001 η <sup>2</sup> = 0.336	P = 0.002 η <sup>2</sup> = 0.104
	Control	9.20 ± 2.47	9.63 ± 4.35	9.36 ± 5.11				
	Test* (P-value, Cohen's d)	P = 0.309	P < 0.001, d = 1.146	P < 0.001, d = 1.037				

Abbreviations: SD: Standard deviation; ANOVA: Analysis of variance; η<sup>2</sup>: Eta squared (effect size); A: Significant difference with first-time point (at baseline). \*: Independent samples t-test (between-group comparison); ¶: Within-group comparison

**Table 6** Between-group and within-group comparison of the mean score of caregivers' care burden scores

Variable	Groups	At baseline Mean ± SD	Immediately after the intervention Mean ± SD	2 months after the intervention Mean ± SD	Repeated measurement ANOVA			
					Single (P-value, η <sup>2</sup> )	Overall (P-value, η <sup>2</sup> )	Time × Group	
Care burden	Experimental	80.23 ± 7.99	65.43 ± 16.52 <sup>A</sup>	60.53 ± 21.34 <sup>A</sup>	P < 0.001, η <sup>2</sup> = 0.450 P = 0.323	P < 0.001 η <sup>2</sup> = 0.220	P = 0.007 η <sup>2</sup> = 0.120	P = 0.002 η <sup>2</sup> = 0.100
	Control	80.13 ± 8.76	77.60 ± 18.45	75.23 ± 16.68				
	Test (P-value, Cohen's d)	P = 0.963	P = 0.009, d = 0.695	P = 0.004, d = 0.767				

Abbreviations: SD: Standard deviation; ANOVA: Analysis of variance; η<sup>2</sup>: Eta squared (effect size); A: Significant difference with first-time point (at baseline). \*: Independent samples t-test

group in comparison to the control group [23]. Also, a review study has specifically focused on the positive outcomes of an educational program in terms of reducing the burden faced by caregivers [42]. In addition, the studies conducted by Abd-Elkhalik and Jung demonstrated the effectiveness of an educational program in reducing caregiver burden scores among stroke family caregivers [43, 44]. Another study found that the care burden of stroke caregivers tends to increase after discharge if proper intervention is not provided. As a potential solution, the study proposes the implementation of an educational program, which has proven to be effective [21]. The process of educating patients and their caregivers should ideally commence during the hospitalization period and extend beyond their homes or even a nursing home [45]. The utilization of educational programs by nurses can significantly alleviate the care burden experienced by family caregivers [46, 47]. The results of previous studies were in line with the findings of the present study, suggesting that similar outcomes may be due to the implementation of a specific educational program during hospitalization and post-discharge periods compared to the standard hospital education. A stroke educational program was provided to participants in the intervention group in the present study. In addition, to ensure that participants received the educational content and to

answer any questions, a weekly telephone follow-up was conducted. Given the potential influence of these factors on the intervention's effectiveness, it is crucial to recognize this as a key point that should not be overlooked.

**Study limitations**

The short follow-up period in this study was a limitation due to grant limitations and large study groups. There were also limitations in the study due to the small sample size as a result of the limited number of stroke centers affiliated with Shahid Beheshti University of Medical Sciences. In view of this, future studies in this area should use a larger sample size. Furthermore, convenience sampling is associated with a significant risk of selection bias in this study. So, including other sampling methods in future studies is recommended. Due to the fact that this was not a multicenter trial study, the study results were not very generalizable. In addition, it was necessary to conduct follow-up and phone counseling sessions with family caregivers to ensure their continued involvement until the final data collection phase, which could adversely affect the final results.

## Conclusion

The utilization of an online training program has been proven to have a significant effect on improving the quality of life for stroke patients and reducing the care burden of their caregivers. Therefore, the role of nurses in educating patients and caregivers after discharge is crucial, necessitating its effective implementation in medical centers and emphasis on health and educational policies.

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## Author contributions

Design of the study: AN, MZ, RK, AA; data collection: AN; analysis and interpretation of data: AN, VY; manuscript preparation: AN, MZ, RK, AA; manuscript revision: AN, MZ, RK, AA. All authors checked and confirmed the final manuscript before submission. The authors read and approved the final manuscript.

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## Data availability

On request, the corresponding authors will provide the datasets that were used and analyzed in the current study.

## Declarations

### Ethics approval and consent to participate

Participants in the study were provided with information about the purpose of the study and the assurances were given to them regarding the protection of their privacy and confidentiality. They were informed that the study is optional, and they possess the freedom to discontinue their involvement whenever they choose. Before participating in the study, they signed a consent form. Additionally, Shahid Beheshti University of Medical Sciences' Review Board approved the study. This study was approved by the Research Committee of Shahid Beheshti University of Medical Sciences (No: IR.SBMU.PHARMACY.REC.1402.178).

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

### Protocol registration

The study protocol was registered in the Iranian Registry of Clinical Trials (No: IRCT20240609062065N1, 2024/08/31).

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