Neurology Asia 2024; 29(2) : 341 – 349

Telerehabilitation-based training to improve balance confidence, falls efficacy, functional independence in individuals with stroke: a randomized controlled trial

[1]Fatih Özden *PT PhD*, [2]Mehmet Özkeskin *PT PhD*, [3]Bennu Deniz Ezgin *PT MSc*, [4]İsmet Tümtürk *PT MSc*, [5]Bedriye Karaman *MD*, [5]Hadiye Şirin *MD*

[1]Muğla Sıtkı Koçman University, Köyceğiz Vocational School of Health Services, Department of Health Care Services, Muğla, Turkey; [2]Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ege University, İzmir, Turkey; [3]Institute of Health Sciences, Department of Physiotherapy and Rehabilitation, Ege University, İzmir, Turkey; [4]Institute of Health Sciences, Department of Physiotherapy and Rehabilitation, Süleyman Demirel University, Isparta, Turkey; [5]Faculty of Medicine, Department of Neurology, Ege University, İzmir, Turkey

Abstract

Background: The aim of the study was to investigate the effectiveness of telerehabilitation-based balance and coordination exercises on balance confidence, fall efficacy, and functional independence in stroke patients. *Methods:* A double-blind, randomized controlled trial was conducted on 30 stroke patients (15 in the telerehabilitation-based group and 15 in the paper-based control group). The telerehabilitation group received video-based exercise training, while the control group received paper-based exercise training. Fear of falling (FES-I), balance (ABC), self-management (SSEQ) and satisfaction with telemedicine (TSQ) were evaluated before and six weeks after treatment. *Results:* The results of the present study showed that both telerehabilitation-based video training and paper-based exercise prescription methods were effective in terms of balance confidence, fall efficiency and stroke-specific functional independence ($p<0.05$). Besides, telerehabilitation-based video training was more effective in balance confidence ($p=0.042$) and functional independence (0.018). In addition, the satisfaction of individuals in the telerehabilitation group with the telerehabilitation application was above average (59.73±8.15).

Conclusion: Telerehabilitation-based video exercises in stroke patients may provide additional advantages in terms of balance confidence and fall efficiency. In addition, individuals with stroke were satisfied with the remote rehabilitation application.

Keywords: Balance, coordination, remote rehabilitation, stroke, telehealth

INTRODUCTION

Stroke is one of the major causes of neurological disability. Functional impairments are observed after stroke, and the most commonly reported problems include impairments in mobility (58%). Approximately 12-43% of individuals demonstrate more mobility impairment, especially in the chronic period of stroke.[1,2] In addition to decreased mobility, health-related quality of life decreases due to impaired balance, increased risk of falls, decreased cardiorespiratory capacity and psychological effects such as depression and decreased self-confidence.[3] Studies have revealed that approximately 35% of individuals with stroke require assistance in performing activities of daily living such as walking, eating, dressing, personal care and hygiene.[4,5]

Rehabilitation programs after stroke include neurodevelopmental therapies, electrotherapy, personalized strengthening and balance exercises in the early period in the hospital or later in outpatient rehabilitation units. However, social and psychological conditions such as limited time, expensive rehabilitation programs, and transportation problems affect effective and

Address correspondence to: Fatih Özden, PT. PhD., Muğla Sıtkı Koçman University, Köyceğiz Vocational School of Health Services. Department of Health Care Services, 48800, Köyceğiz/Muğla/Turkey. E-mail: fatihozden@mu.edu.tr

Date of Submission: 25 July 2023; Date of Acceptance: 16 January 2024

https://doi.org/10.54029/2024npu

timely rehabilitation.[6,7] A study has suggested that it may be crucial to deliver efficacious and cost-effective treatments to enhance the clinical condition of patients and maximize the benefit of existing healthcare budgets.[8] Therefore, alternative methods such as home-based telerehabilitation have started to be applied in the monitoring of chronic diseases. Telerehabilitation is becoming one of the most continually preferred choices, particularly in the last decade. Telerehabilitation is evolving as an optional, low-cost treatment method to conventional "face-to-face" rehabilitation procedures and in-home supervision services. This rehabilitation procedure contains multifarious benefits such as "follow-up intervention, supervision, education, counselling and consultation".[9] In home-based rehabilitation, either the physiotherapist visits the stroke patient at home at regular intervals or telecommunication methods are used to obtain information about the patient's condition.[10]

Many randomized controlled trials have shown that home-based telerehabilitation programs improve motor skills, postural balance, sitting and standing balance, walking skills, self-efficacy, daily living activities and quality-of-life in individuals with stroke. In addition, easy access, caregiver-assisted treatment, flexible treatment time, and enabling patients to perform activities similar to daily life in their environment provide additional advantages.[11-17] A systematic review of 22 studies reported that telerehabilitation after a stroke had better results or equally beneficial effects on motor skills and mood disorders than conventional treatment.[10] No other studies have investigated the efficacy of video exercise-based telerehabilitation on balance confidence, fall efficacy, and functional independence in stroke patients. The study aimed to investigate the effect of telerehabilitation-based balance and coordination exercises on balance confidence, fall efficacy, and functional independence in individuals with stroke.

METHODS

Study design and participants

A double-blind, randomized controlled trial was conducted on 30 stroke patients, followed by the Ege University Neurology outpatient clinic between August 2022 and February 2023. This study was accomplished following the "CONsolidated Standards of Reporting Trials (CONSORT)" and "Standard Protocol Items: SPIRIT (Statement of Recommendations for Interventional Trials)" guidelines.

The inclusion criteria of the study were as follows: (1) stroke patients after one month of the diagnosis, (2) non-aphasic stroke patients aged 18 to 65 years, (3) patients without other neurological diseases, (4) being able to understand commands, (5) >24 on Mini-Mental Status Test, (6) being able to maintain an upright posture and being able to walk at least 10 meters without assistance using a cane, crutch or walker. Exclusion criteria were defined as: (1) Conditions that would prevent the performance of assessments or communication with the individual, (2) other major clinical conditions that may affect evaluation and/or treatment. Initially, 42 individuals with stroke were included in the study. Ten were excluded for various reasons. Thirty-two people were randomized into two groups. Two cases were lost to follow-up. As a result, a total of 30 individuals (15 in the telerehabilitation-based group and 15 in the paper-based control group) were included in the analysis (Figure 1).

Recruitment

One of the investigators presented the study to the participants. Individuals whose eligibility for the study was evaluated by a physician and invited to include in the study. An informed consent form was given to patients who agreed to participate in the study. Initial evaluation data were collected in the neurology outpatient clinic.

Sample size

The sample size was calculated with G-Power 3[18], considering the effect size of the reference study with a similar design and subject.[15] According to the changes in functionality level (Barthel Index) of both groups, the effect size value was calculated as 0.94 (80% power and 95% confidence level). A total of 30 patients (15 cases for both groups) were calculated to be adequate.

Ethical consideration

The study was carried out in accordance with the ethical principles and the Helsinki Declaration. Informed consent of the patients was obtained. The study protocol was approved by the ethics committee of Ege University (No: 22-4/4, Date: 05.04.2022). The study protocol was registered (ClinicalTrials.gov Identifier: NCT05251571).

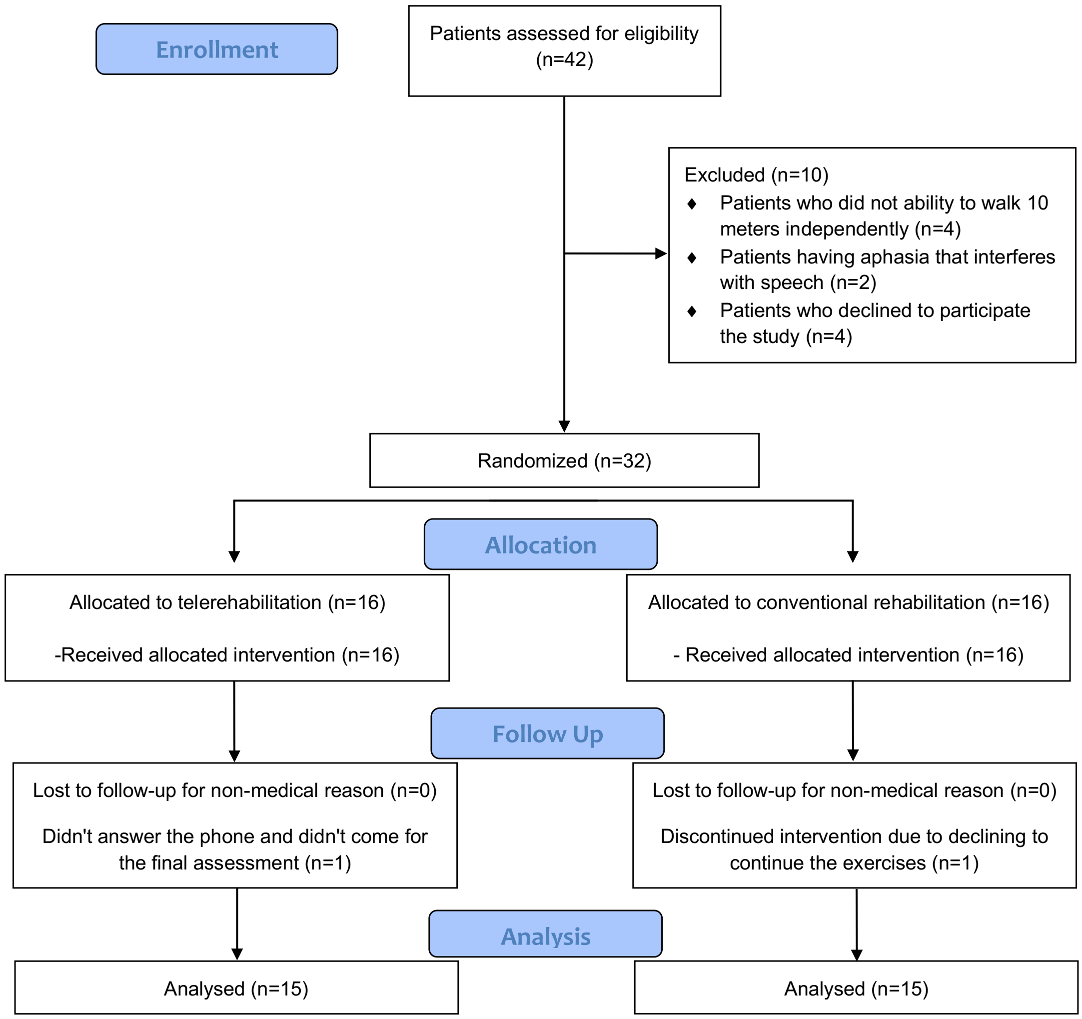

Figure 1. CONSORT flow chart of the study

Randomization and blinding

Assessor of the study (A clinical physiotherapist) at baseline and week eight were blinded. After recruitment, randomization software divided participants into video-based telerehabilitation and paper exercise groups. A clinician recorded the allocations of the randomization software. Allocation was concealed by the same clinician during the trial. Participants were provided with the groups they were included in, confidential in a sealed envelope. All identifying information of the individuals participating in the study was kept confidential.

Interventions

The telerehabilitation group received video-based exercise training, while the control group received paper-based exercise training. Patients in both groups have instructed the exercises as follows: (1) terminal extension, (2) bridging, (3) clam, (4) bilateral arm elevation, (5) sit-to-stand exercise, (6) "Wand" exercises in flexion-abduction direction, (7) tandem walking, (8) side walking (Figure 2). Patients were asked to perform the exercises twice daily (preferably morning-evening) for ten repetitions each. Patients who could not perform side walking without support were offered different exercise modifications and progressions, such as changing the number of sets and repetitions to construct a minimal difference between exercise protocols.

Telerehabilitation based video exercise group

Video exercise contents of the video-based telerehabilitation group were sent via an online mail link. The videos included practical and

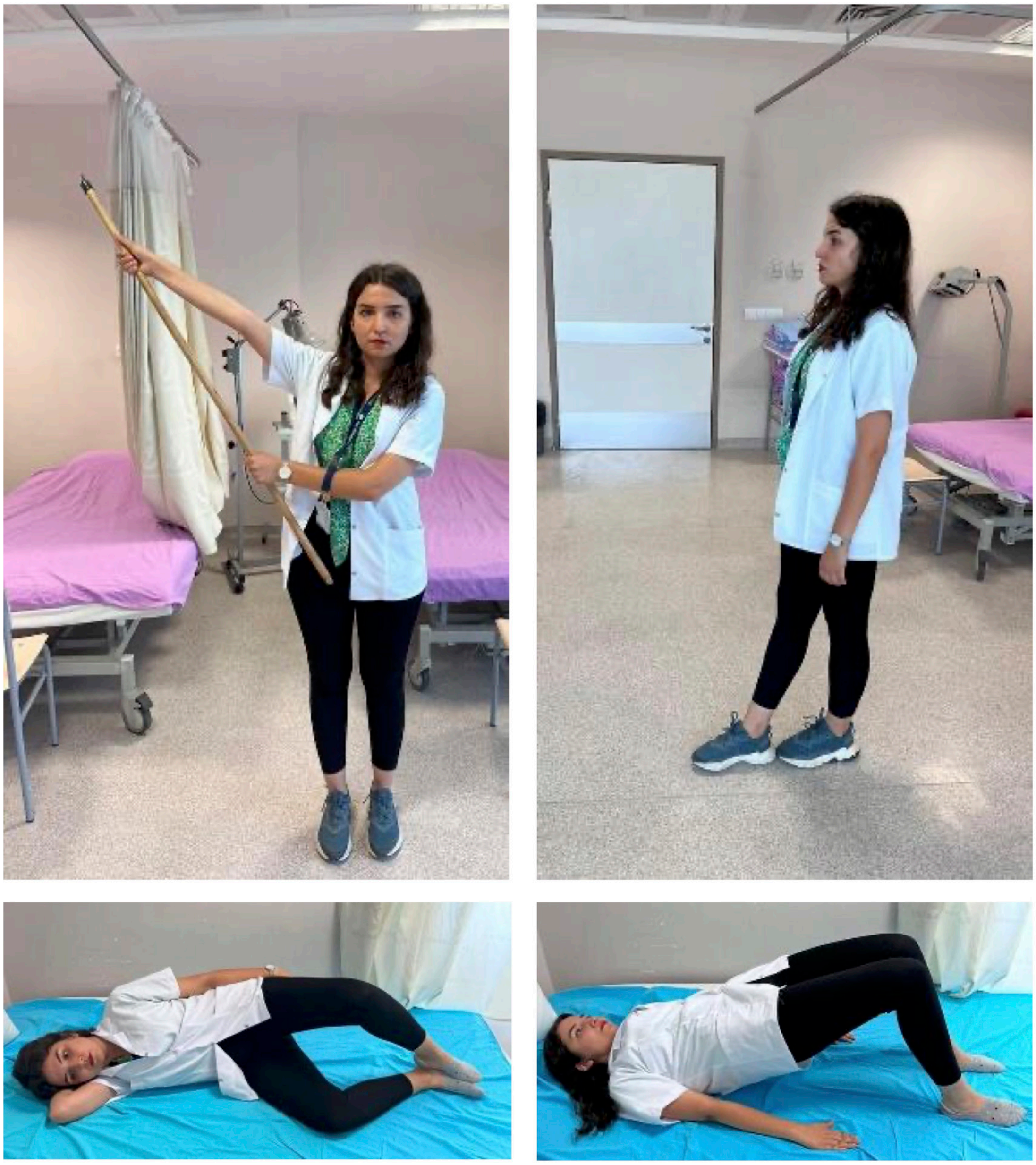

Figure 2. Exercise samples from the rehabilitation protocol

detailed explanations by the physiotherapist. The patient was called every two weeks, a motivational discourse was constructed, and information about the patient's condition was obtained.

Paper based exercise group

Patients in the paper-based exercise group were given the home exercise program in paper form after the evaluation on the first day of inclusion in the study. The exercise description, the number of sets and repetitions, and a photograph of the exercise were included on the paper. When necessary, the number of sets and repetitions were changed according to the patient's condition in a way that did not make a minimal difference.

Data collection

Before starting the treatment, demographic data and clinical and physical characteristics of all individuals participating in the study were recorded. Fear of falling, balance, self-management and satisfaction with telemedicine were evaluated before and six weeks after treatment.

Falls Efficacy Scale-International (FES-I): The FES-I has 16 questions to consider individuals' apprehensions concerning falls. Each question is scored between "0-4". The Turkish version of the FES-I was validated by Ulus *et al.*[19]

Activity Specific Balance Confidence Scale (ABC): The ABC contains 16 daily life tasks to estimate the balance confidence of the individuals. A total score is ranged from "0% (no confidence)" to "100% (full confidence)". The Turkish version was validated by Ayhan *et al*.[20]

Stroke Self-Efficacy Questionnaire (SSEQ): The 13-item SSEQ evaluates the self-efficacy of individuals in daily living activities. Each question is scored on an 11-point scale. The total score is ranged from 0 to 130). Turkish versions of the questionnaire were developed by Topçu and Oğuz[8] and Arkan *et al*.[9]

Telemedicine Satisfaction Questionnaire (TSQ): TSQ consists of 14 items to assess patients' level of satisfaction with telerehabilitation. The total score of TSQ is ranged from 14 to 70. The Turkish version of the TSQ was validated by Özden *et al*.[21]

Statistical analysis

Statistical Package for Social Sciences (SPSS) Version 25.0 (SPSS inc, Chicago, IL, USA) was used for data analysis. Continuous variables were expressed as mean ± standard deviation, and categorical variables as number and percentage. The normal distribution was analyzed with "One-Sample Kolmogorow-Smirnow Test". The Mann-Whitney U test was used to compare independent group differences of FES-I, ABC, SSEQ, TSQ. In-group comparisons were conducted with the Friedman test was used. In addition, the differences between categorical variables (e.g., gender) were analyzed by Pearson chi-square analysis. Statistical significance was evaluated at the $p<0.05$ level in all analyses.

RESULTS

Patient characteristics

A total of 30 patients (62.47±9.70; minimum=39, maximum=83 years, 8 female and 22 male) were included in the study. The mean values and frequencies of the patient characteristics are presented in Table 1. There was no significant difference between the groups ($p>0.05$).

Falls Efficacy Scale-International

The changes in the FES-I scores are reported in Table 2. Significant differences were found in the FES-I scores in the telerehabilitation-based video group and paper-based control group ($p<0.001$; $p=0.0021$, respectively). On the contrary, there were no significance between-group analyses ($p>0.05$).

Activities-Specific Balance Confidence Scale

The ABC scores showed in Table 2. telerehabilitation-based video group demonstrated significant improvement ($p<0.001$). In addition,

Table 1: Demographic and clinical characteristics of the participants

	Intervention Group (n=15)	Control Group (n=15)	p
Gender (female/male, %)	33.3/66.7	20/80	0.682[a]
Age (years, mean±SD)	63.87±8.39	61.07±10.97	0.775[b]
BMI (kg/m^2, mean±SD)	28.05±5.07	28.99±2.33	0.520[c]
Living area (urban/rural, %)	93.3/6.7	93.3/6.7	1.000[d]
Education status (primary/high school and above, %)	86.7/13.3	66.7/33.3	0.390[a]
Smoking status (current/never, %)	20/80	33.3/66.7	0.682[a]
Marital status (married/single, %)	86.7/13.3	93.3/6.7	0.543[d]
Presence of chronic disease (present/absent, %)	86.7/13.3	80/20	0.624[d]
Symptom duration (months, mean±SD)	15.13±15.34	34.63±54.73	0.412[b]
Affected side (right/left, %)	46.7/53.3	53.3/46.7	0.715[d]

n: number of participants, **SD:** standard deviation, **BMI:** body mass index, **kg:** kilogram, **m:** meter, **a:** Fisher's exact test, **b:** Mann-Whitney U test, **c:** independent sample t test, **d:** Pearson chi-square test

Table 2: Patient self-reported outcome measures between and within groups

		Intervention Group (n=15)	Control Group (n=15)	p (between group)
FES-I[*]	**Before treatment (mean±SD)**	38.86±7.16	40.8±5.67	0.285[a]
	After treatment (mean±SD)	28.46±4.56	32.2±5.06	0.061[a]
	Δ (mean)	-10.4±5.18	-8.6±5.15	0.412[a]
	p (within group)	**0,000002[b]**	**0.001[c]**	
ABC[**]	**Before treatment (mean±SD)**	56.42±10.67	56.71±7.83	0.934[d]
	After treatment (mean±SD)	69.66±8.29	65.64±9.59	0.229[d]
	Δ (mean)	13.24±4.46	8.93±6.43	**0.042[d]**
	p (within group)	**0.000000016[b]**	**0,000098[b]**	
SSEQ[**]	**Before treatment (mean±SD)**	23.13±4.73	22.13±4.53	0.713[a]
	After treatment (mean±SD)	31.86±4.07	26.47±4.42	**0.003[a]**
	Δ (mean)	8.73±3.79	4.33±5.6	**0.018[d]**
	p (within group)	**0.00000037[b]**	**0.01[b]**	
TSQ[**]	**After treatment (mean±SD)**	59.73±8.15	n/a	n/a

n: number of participants, **SD:** standard deviation, **FES-I:** Falls Efficacy Scale-International, **ABC:** Activities-Specific Balance Confidence Scale, **SSEQ:** Stroke Self-Efficacy Questionnaire, **TSQ:** Telemedicine Satisfaction Questionnaire, **a:** Mann-Whitney U test, **b:** paired t test, **c:** Wilcoxon signed-rank test, **d:** independent sample t test, [*]**:** Lower values = Better, [**]**:** Higher values = Better

the paper-based control group also improved significantly (p<0.001). On the other hand, adjusted between-group analysis established a significant improvement in the telerehabilitation-based video group (p<0.05).

Stroke Self-Efficacy Questionnaire

The score changes of the SSEQ are presented in Table 2. Telerehabilitation-based video and paper-based control groups illustrated significantly improved SSEQ scores (p<0.001; p=0.01, respectively). In addition, between-group analyses revealed significant improvement in the telerehabilitation-based video group (p<0.05).

Telemedicine Satisfaction Questionnaire

The TSQ result is given in Table 2. According to the post-treatment questionnaire results, the telemedicine satisfaction level of the telerehabilitation-based video group was 59.73±8.15.

DISCUSSION

The results of the present study showed that both telerehabilitation-based video training and conventional paper-based exercise prescription methods were effective in terms of balance confidence, fall efficiency and stroke-specific functional independence. Besides, telerehabilitation-based video training group provided better improvement in balance confidence and functional independence. In addition, the satisfaction of individuals in the telerehabilitation group with the telerehabilitation application was above average. These results revealed that balance and coordination-based video exercise intervention might provide additional positive improvements in the clinical status of individuals in terms of balance and stroke self-efficacy. Telerehabilitation applications are expected to satisfy individuals by providing motivation and adaptation, and effective treatment at a distance.[22] Our study found that the video exercise program offered with the online mail link satisfied the patients above the medium level and was able to meet the expectations in the context of remote rehabilitation.

Balance confidence, one of the psychological parameters of balance, indicates that individuals act with confidence in activities requiring static and dynamic balance during various daily life activities.[23] Due to the decreased balance ability of individuals with stroke, a decrease in balance confidence following stroke attracts engagement.[24] For this purpose, in our study, we aimed to improve balance abilities with "tandem walking" and "side walking" exercises with video exercises within the scope of telerehabilitation. Although our results revealed improved balance confidence for both groups, the telerehabilitation group was provided better improvement in balance parameter to the conventional exercise group. We interpreted that video-based applications provide more effective clinical outcomes regarding balance regarding its multimedia sources providing visual and auditory directions. However, it may be efficient to provide more comprehensive objective measurements from static and dynamic balance assessment tools to reveal the objective development of balance.[23,24]

Fall efficacy, another parameter we addressed in our study, was evaluated to obtain information about the fall risks of individuals with decreased balance abilities.[25] The exercise program we offered to increase the balance-coordination abilities of individuals improved the fall efficiency score in both groups.[26] However, contrary to our hypothesis, video exercise was inferior to the paper-based exercise protocol.

In terms of stroke self-efficacy, which represents individuals' level of functional independence in activities of daily living and stroke-related symptoms, the treatment provided positive clinical results in both groups.[1,8] However, confirming our hypothesis, the video-based exercise group significantly improved more than the paper-based exercise group. In addition to balance and coordination exercises in our exercise protocol, the strengthening, range of motion and postural stabilization exercises that we included in the prescription may have effectively increased independence in daily life. In the video-based exercise group, we interpreted that the application procedures of the exercises may have been conveyed more effectively to individuals with stroke. For instance, it can be inferred that an isometric contraction or waiting in a specific position for an appropriate period is an essential detail in terms of increasing the effectiveness of the exercise, so it can be inferred that exercises can be explained more effectively with multimedia resources.[11,14]

The effectiveness of telerehabilitation in stroke patients has been demonstrated in various studies. In a pilot study conducted by Jarbandhan *et al.* on 30 chronic stroke patients for eight weeks, the intervention group received a home-based semi-supervised exercise program while the control group received conventional treatment. The results showed that the home-based semi-supervised rehabilitation program improved safe, moderate-to-high participation and walking.[13] In this study, the effectiveness of the home program without telerehabilitation method was discussed. In our study, offering telerehabilitation with a home program may have provided an advantage. Also in our study, a semi-supervised model was provided through telephone patient follow-up.

Lim *et al.* conducted a randomized controlled study on 17 chronic stroke patients for six weeks; the intervention group received home-based exercise training, while the control group received clinic-based exercise training. At the end of 6 weeks, it was reported that the home-based group provided positive postural balance and gait benefits compared to the clinic-based exercise group.[12] In addition to the authors' emphasis on postural balance and gait gain, in our study, our focus on balance confidence and fall activity, a psychological sub-parameter of balance, provided efficient clinical outcomes. The results of the two studies show that both physical and psychological aspects of balance are in harmony. Different from our study, this study focuses on tele-counselling and supervision. Therefore, it would not be possible to claim that the results are fully comparable in terms of the effectiveness of video exercise. In a 12-week study on 30 chronic stroke patients, core exercises were given to the intervention group in the home-based app in addition to conventional treatment. It should be said that the intervention is similar in concept to our study in terms of offering a telerehabilitation similar to our study with a video and photo-supported mobile application. The results showed that telerehabilitation application, in addition to conventional treatment, improved trunk function and sitting balance.[11] The fact that some exercises in our study provided core stabilization training also supported this study's results. In particular, core stabilization was also effective in terms of balance confidence and functional independence, suggesting that core training may be effective in activities of daily living that require dynamic balance.

In a 12-week program on 52 stroke patients, Chen *et al.* gave a home-based motor learning telerehabilitation program to the intervention group while the control group received conventional rehabilitation. They reported increased functional connectivity on motor function and primary motor cortices according to Fugl Meyer assessment in the telerehabilitation group. It has been reported that home-based rehabilitation training is feasible, safe and effective.[15] The motor learning method was not used in our study. How effective motor learning with telerehabilitation can be regarding balance and falls is a matter of curiosity for future studies.

In a randomized controlled study conducted by Nordin *et al*. on 91 stroke patients, the control group received hospital-based group treatment. In contrast, the intervention group received caregiver-assisted treatment at home. Home-based caregiver-assisted treatment was as effective as hospital-based group treatment in improving functions and quality of life after stroke. Easy access to home-based telerehabilitation and caregiver-assisted treatment, flexible treatment time, and enabling patients to perform activities similar to daily life in their environment provide advantages.[17] Contributing to this perspective is our study's telerehabilitation satisfaction effectiveness analysis. The fact that the sample was more than moderately satisfied with the video exercise-based telerehabilitation application supports the importance of motivation and other additional advantages.

This study has the following limitations. Objective measures of balance and coordination could not be used due to the available facilities and setting. Future studies should investigate the gains of telerehabilitation-based video exercise training in objective parameters regarding balance and stabilization. Finally, we did not include geriatric stroke patients in our sample because of the mental and physical homogeneity of the sample to adapt to telerehabilitation. Therefore, telerehabilitation-based balance and coordination exercises could also focus on stroke patients aged 65 years and older.

In conclusion, the results of the present study showed that both telerehabilitation-based video training and conventional paper-based exercise prescription methods were effective in terms of balance confidence, fall efficiency and stroke-specific functional independence. Telerehabilitation-based video training was more effective in terms of balance confidence and functional independence. In addition, the satisfaction of individuals in the telerehabilitation group with the telerehabilitation application was above average.

DISCLOSURE

Financial support: None

Conflict of interest: None

REFERENCES

1. Vahlberg B, Cederholm T, Lindmark B, *et al*. Factors related to performance-based mobility and self-reported physical activity in individuals 1-3 years after stroke: a cross-sectional cohort study. *J Stroke Cerebrovasc Dis* 2013;22(8): 426-34. doi: 10.1016/j.jstrokecerebrovasdis.2013.04.028.
2. Akbar M, Misbach J, Susatia F, *et al*. Clinical features of transient ischemic attack or ischemic stroke patients at high recurrence risk in Indonesia. *Neurol Asia* 2018;23(2): 107-13.
3. Vahlberg B, Cederholm T, Lindmark B, *et al*. Short-term and long-term effects of a progressive resistance and balance exercise program in individuals with chronic stroke: a randomized controlled trial. *Disabil Rehabil* 2017;39(16): 1615-22. doi: 10.1080/09638288.2016.1206631.
4. Hendricks HT, Van Limbeek J, Geurts AC, *et al*. Motor recovery after stroke: a systematic review of the literature. *Arch Phys Med Rehabil* 2002;83(11): 1629-37. doi: 10.1053/apmr.2002.35473.
5. Walsh ME, Galvin R, Loughnane C, *et al*. Community re-integration and long-term need in the first five years after stroke: results from a national survey. *Disabil Rehabil* 2015;37(20): 1834-38. doi: 10.3109/09638288.2014.981302.
6. Billinger SA, Arena R, Bernhardt J, *et al*. Physical activity and exercise recommendations for stroke survivors: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke* 2014;45: 2532-53. doi: 10.1161/STR.0000000000000022.
7. Godwin KM, Wasserman J and Ostwald SK. Cost associated with stroke: outpatient rehabilitative services and medication. *Top Stroke Rehabil* 2011;18(Suppl 1): 676-84. doi: 10.1310/tsr18s01-676
8. Topçu S and Oğuz S. Translation and validation study for the stroke self-efficacy questionnaire in stroke survivors. *Int J Clin Pract Suppl* 2018; 24(4): e12646. doi: 10.1111/ijn.12646
9. Arkan G, Beser A, Haney MO, *et al*. Psychometric testing of the Turkish version of the Stroke Self-Efficacy Questionnaire. *J Nurs Res* 2019;27: e35. doi: 10.1097/jnr.0000000000000308.
10. Sarfo FS, Ulasavets U, Opare-Sem OK, *et al*. Tele-rehabilitation after stroke: an updated systematic review of the literature. *J Stroke Cerebrovasc Dis* 2018;27(29): 2306-18. doi: 10.1016/j.jstrokecerebrovasdis.2018.05.013.
11. Salgueiro C, Urrútia G and Cabanas-Valdés R. Telerehabilitation for balance rehabilitation in the subacute stage of stroke: A pilot controlled trial. *NeuroRehabilitation* 2022;51(1): 91-9. doi: 10.3233/NRE-210332.
12. Lim JH, Lee HS, Song CS. Home-based rehabilitation programs on postural balance, walking, and quality of life in patients with stroke: A single-blind, randomized controlled trial. *Medicine* 2021;100(35): e27154. doi: 10.1097/MD.0000000000027154.
13. Jarbandhan A, Toelsie J, Veeger D, *et al*. Feasibility of a home-based physiotherapy intervention to promote post-stroke mobility: A randomized controlled pilot

study. *Plos One* 2022;17(3): e0256455. doi: 10.1371/journal.pone.0256455.
14. Cramer SC, Dodakian L, Le V, *et al*. Efficacy of home-based telerehabilitation vs in-clinic therapy for adults after stroke: a randomized clinical trial. *JAMA Neurol* 2019;76(9): 1079-87. doi: 10.1001/jamaneurol.2019.1604.
15. Chen J, Sun D, Zhang S, *et al*. Effects of home-based telerehabilitation in patients with stroke: a randomized controlled trial. *Neurology* 2020;95(17): 2318-30. doi: 10.1212/WNL.0000000000010821.
16. Wong FKY, Wang SL, Ng SS, *et al*. Effects of a transitional home-based care program for stroke survivors in Harbin, China: a randomized controlled trial. *Age Ageing* 2022;51(2): afac027. doi: 10.1093/ageing/afac027.
17. Nordin NAM, Aziz NA, Sulong S, *et al*. Effectiveness of home-based carer-assisted in comparison to hospital-based therapist-delivered therapy for people with stroke: A randomised controlled trial. *NeuroRehabilitation* 2019;45(1): 87-97. doi: 10.3233/NRE-192758.
18. Faul F, Erdfelder E, Lang AG, *et al*. G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods* 2007;39(2): 175-91. doi: 10.3758/bf03193146.
19. Ulus Y, Durmus D, Akyol Y, *et al*. Reliability and validity of the Turkish version of the Falls Efficacy Scale International (FES-I) in community-dwelling older persons. *Arch Gerontol Geriatr* 2012;54(3): 429-33. doi: 10.1016/j.archger.2011.06.010.
20. Ayhan Ç, Büyükturan Ö, Kırdı N, *et al*. The Turkish version of the activities specific balance confidence (ABC) scale: Its cultural adaptation, validation and reliability in older adults. *Turk J Geriatr* 2014;17(2): 157-63.
21. Özden F, Özkeskin M, Sarı Z, *et al*. The reliability and validity of the Turkish version of the telehealth usability questionnaire and the telemedicine satisfaction questionnaire in patients with multiple sclerosis. *Neurol Sci Neurophysiol* 2021;38: 173-9. doi: 10.4103/nsn.nsn_41_21
22. Lloréns R, Noé E, Colomer C, *et al*. Effectiveness, usability, and cost-benefit of a virtual reality–based telerehabilitation program for balance recovery after stroke: A randomized controlled trial. *Arch Phys Med Rehabil* 2015; 96(9): 418-25. doi: 10.1016/j.apmr.2015.03.025.
23. Bobić Lucić L and Grazio S. Impact of balance confidence on daily living activities of older people with knee osteoarthritis with regard to balance, physical function, pain, and quality of life–a preliminary report. *Clin Gerontol* 2018;41(4): 357-65. doi: 10.1080/07317115.2018.1453907.
24. Karthikbabu S, Verheyden G. Relationship between trunk control, core muscle strength and balance confidence in community-dwelling patients with chronic stroke. *Top Stroke Rehabil* 2021;28(2): 88-95. doi: 10.1080/10749357.2020.1783896.
25. Weerdesteijn V, Niet Md, Van Duijnhoven H, *et al*. Falls in individuals with stroke. *JRRD* 2008;45(8): 1195-214.
26. Cadore EL, Rodríguez-Mañas L, Sinclair A, *et al*. Effects of different exercise interventions on risk of falls, gait ability, and balance in physically frail older adults: a systematic review. *Rejuvenation Res* 2013;16(2): 105-14. doi: 10.1089/rej.2012.1397.