



Research Article

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Comparison of the Effects of Physiotherapy Alone and Video Game-Based Therapy Plus Physiotherapy on Depression and Muscle Strength in Post-Stroke Patients

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Abstract

Background and Objective: *Depression is one of the most common problems in stroke patients, which can undermine the quality of life in these patients. In this study, we aimed to evaluate and compare improvement in muscle strength and power as well as post-stroke depression in the two groups of physiotherapy alone and video game-based therapy plus physiotherapy.*

Materials and Methods: This clinical trial was carried out among 26 patients (n=13 per group) at the Department of Neurology of Kashan Hospital affiliated to Isfahan University of Medical Sciences, Iran, during April to July 2019. The control group received 24 sessions (3 sessions per week for 8 weeks) of physiotherapy which lasted 45 minutes. The intervention group, on the other hand, received physiotherapy along with video game-based therapy. Muscle strength was evaluated using the Brunnstrom approach and depression was assessed using Beck's Depression Inventory. All the analyses were performed using SPSS version 25.

Results: A total of 26 patients (18 male and 8 female) participated in the study. The means of Brunnstrom and depression scores were not significantly different between the two groups at the pre-intervention stage. The Brunnstrom and depression scores showed a significant improvement in the intervention group post intervention ($P<0.016$ and $P<0.028$, respectively).

Conclusion: The obtained results support that the Brunnstrom and depression scores improved following video game-based therapy plus physiotherapy. Video game-based therapy along with the routine treatment is effective in improving depression in post-stroke patients.

Keywords: Beck's Depression Inventory, Brunnstrom approach, Physiotherapy, Post-stroke depression, Stroke, Video game-based therapy

Introduction

Stroke also known as cerebrovascular accident is one of the most common life-threatening neurological diseases that occurs suddenly and disrupts blood flow in a part of the brain tissue, restricting oxygen supply to the surrounding cells and resulting in brain tissue damage (1). Stroke is responsible for a significant percentage of mortalities and causes many complications, including mobility and functional problems, vision and speech disorders, and muscle weakness (2). Some of the most common problems in these patients are decreased balance and posture control and functional movement disorders, which increase the probability of falling and instability during movement (3).

One of the most common psychological complications among stroke survivors is depression, which is associated with progressive disability and cognitive impairment in these patients (4). This type of depression is called post-stroke depression, and the involvement of the brain in controlling emotions, worries about work and income, and relationship loss can exacerbate depression in these patients. Post-

stroke depression usually occurs between 6 and 24 months following a stroke, but in some patients, it may even occur up to three years following a stroke (5).

Physiotherapy programs for stroke patients focus on mobility, pain relief, and methods of preventing stroke complications. In these sessions, the physiotherapist tries to return the patient to their daily activities at home, work, and in the community as soon as possible (6). However, physiotherapy alone may prolong the duration of treatment, which increases the risk of depression in these patients (7). The treatment of stroke complications such as severe brain damage and neurological disorders is very complex and cost-intensive. Most patients do not have enough motivation for conventional rehabilitation therapy, and failure to perform these types of exercises completely will hamper effective treatment (8).

Recently, virtual rehabilitation via computer programs has been proposed to help treat a wide range of movement disorders. This method is also commonly employed in post-stroke management (9). Compared to traditional rehabilitation programs, which are often repetitive, lengthy, and tedious, novel treatment methods such as virtual reality programs and computer games can be more effective as biofeedback therapy (10). Computer games that are engaging, purposeful, repetitive, and voluntary can lead to body movement in different directions and speeds and can promote balance in stroke patients (11).

Due to the high prevalence of stroke and the high incidence of post-stroke depression in these patients, we sought to evaluate and compare muscle strength and power as well as post-stroke depression between the two groups of physiotherapy plus video game-based therapy and physiotherapy alone.

Materials and Methods

Study population

This clinical trial was carried out among 26 patients at the Department of Neurology of Kashani Hospital affiliated to Isfahan University of Medical Sciences, Iran, April to July 2019. We included patients who had post-stroke depression based on Beck Depression Inventory (BDI) and muscle strength stage 2 to 5 based on Brainstorm criteria, did not have cerebral hemorrhage, disabilities before the stroke, or previous history of stroke, and were aged between 40 and 75 years old. The exclusion criteria included unwillingness to participate in the study, not completing the therapy sessions, and having cognitive problems. The CONSORT flowchart is presented in Figure 1.

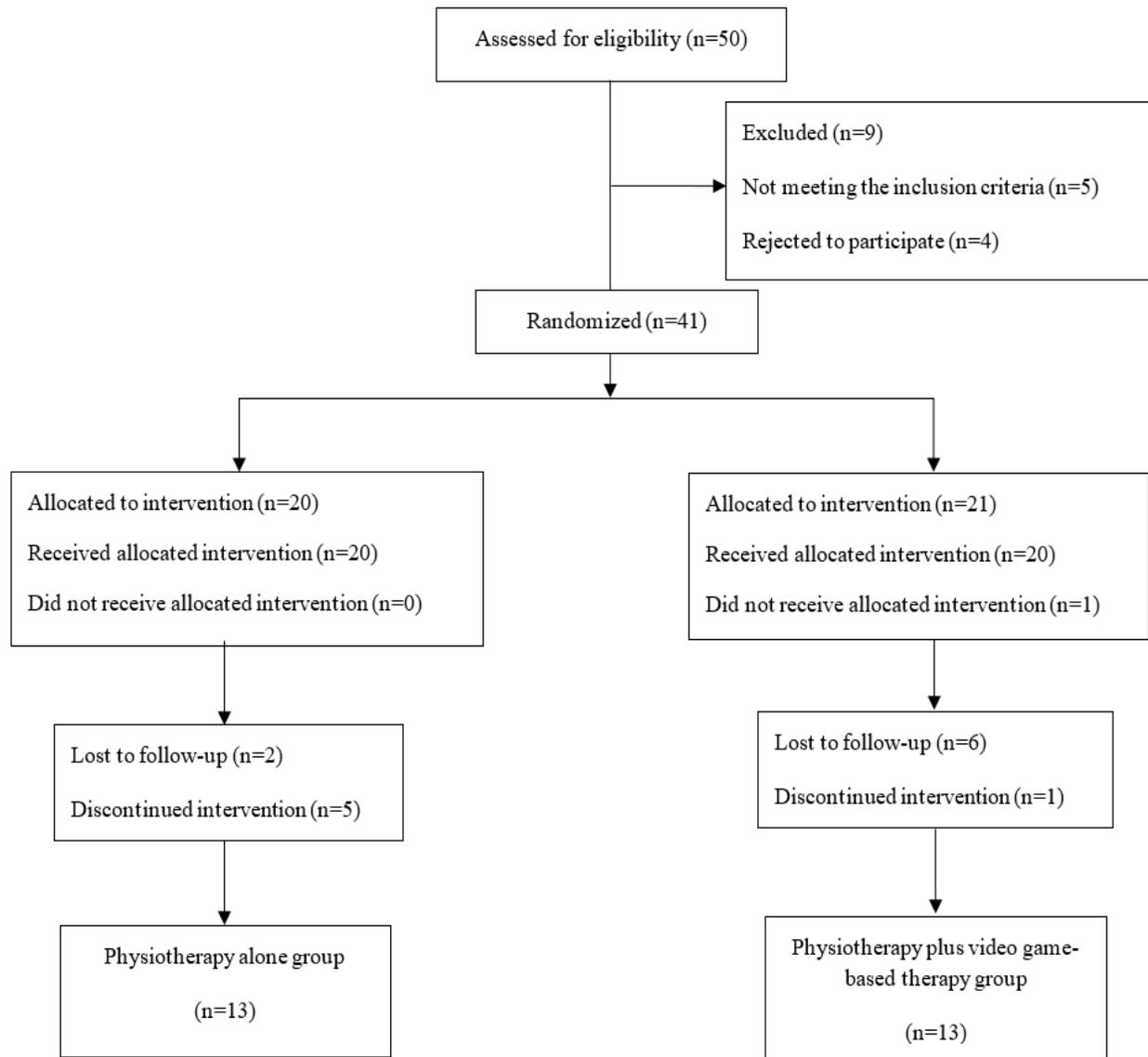


Figure 1. Flowchart diagram of the selection process of the participants

Study protocol

Patients were randomly divided into two groups of 13 based on the random number table. The control group received 24 sessions (3 sessions per week for 8 weeks) of physiotherapy lasting 45 minutes. Physiotherapy was based on the Brunnstrom approach, which is used in patients with movement problems following central nervous system injury. Stages of recovery based on the Brunnstrom approach are shown in Table 1. These stages have been recognized from clinical explanations of a large number of hemiplegic patients as synergy, spasticity, and voluntary movement. The intervention group received

physiotherapy similar to the control group plus video game-based therapy immediately after the end of each session for 20 minutes. In doing so, the video games of PlayStation 4 Pro and PlayStation VR were used as intervention tools, and patients were asked to play the game during the session. Finally, muscle strength and depression were assessed for each patient before and after the intervention and the scores were compared between the control and intervention groups.

Stage	Explanation
1	There is a phase of flaccidity whereby no movement of the limbs on the affected side happens immediately after the stroke.
2	Recovery initiates with increasing spasticity, improved reflexes, and synergic movement. These necessary synergies may manifest with the addition of all or only part of the synergic movement pattern and they happen as a result of feedbacks to stimuli or least movement reactions.
3	Spasticity becomes more obvious and necessary synergies are improved. Voluntary control through the synergy pattern improves, nevertheless the patient might still have limited range of motion.
4	Spasticity and the effect of synergy start to disappear and the patient becomes capable of moving with less restriction.
5	Spasticity continues to reduce, and there is a better capability for the patient to move easily from the synergy pattern. At this time the patient shows isolated joint movements and coordination.
6	Spasticity no longer exists, allowing near-normal to normal movement and coordination.

Table 1: Stages of the Brunnstrom approach

Instruments

Post-stroke depression was evaluated based on Beck's Depression Inventory, which includes 94 items. This questionnaire examines emotions and thoughts such as mood, pessimism, feelings of failure, dissatisfaction, guilt, and other symptoms of depression. Each symptom is rated based on a 4-point Likert-type scale. A score of zero indicates the lowest and a score of 3 indicates the highest severity of a depressive experience. The total scores can range between 0 and 63. This questionnaire is used to assess the severity of depression in people over 13 years old. In this test, scores of 0-13 show minimal depression, 14-19 mild depression, 20-28 moderate depression, and 29-63 severe depression. In this study, the internal consistency method was used to study the validity of the Farsi version of Beck's

questionnaire. Cronbach's alpha coefficients for the whole questionnaire and the first and second factors were 0.86, 0.84, and 0.78, respectively.

Statistical analysis

The descriptive data are summarized as mean, standard deviation, and/or percentage. The normality of the data was examined before data analysis using the Kolmogorov–Smirnov and Levene's tests. Descriptive statistics, such as frequency and relative frequency, and covariance test were used to analyze the data. All the analyses were performed using SPSS, version 25. A P-value of less than 0.05 was considered statistically significant.

Ethical considerations

Prior to conducting this study, all the participants provided written informed consent. The study protocol was reviewed and approved by the Ethics Committees of Isfahan University of Medical Sciences (no.: ...). Furthermore, the study was registered at the Iranian Registry for Clinical Trials (code: ...).

Results

A total of 26 patients (n=13 per group) participated in the study, 18 (96%) of whom were male and 8 (31%) were female. Also, 46% of the patients were within the age range of 45 to 55 years, 23% in the age range of 56 to 65 years, and 31% over 65 years in both groups (Table 2). Effects of stroke on hemisphere show that in 62% of the patients the left hemisphere was involved.

Groups		Control	Intervention	Total
Gender N (%)	Male	9 (69)	9 (69)	18 (69)
	Female	4 (31)	4 (31)	8 (31)
Age N (%)	45 to 55 years old	6 (46)	6 (46)	12 (46)
	56 to 65 years old	3 (23)	3 (23)	9 (23)
	Over than 65 years old	4 (13)	4 (13)	8 (13)
Hemisphere N (%)	Right	3 (23)	7 (54)	10 (38)
	Left	10 (77)	6 (46)	16 (62)

Table 2: Characteristics of the two groups

The results of the Kolmogorov–Smirnov test showed the normality of the data ($P>0.05$). The results of Levene's test demonstrated that all the data was homogeneous ($P>0.05$; Table 3).

Test		Kolmogorov–Smirnov test				Mean \pm SID	
		Z		P-value		Brunnstrom score	Beck score
		Brunnstrom score	Beck score	Brunnstrom score	Beck score		
Pre-intervention	Control group	0.197	0.197	0.175	0.148	3.46 \pm 1.12	24.61 \pm 7.13
	Intervention group	0.197	0.197	0.175	0.20	3.46 \pm 1.12	23.53 \pm 7.29
Post-intervention	Control group	0.237	0.237	0.068	0.114	4 \pm 1.00	19.76 \pm 7.51
	Intervention group	0.189	0.189	0.166	0.20	4.23 \pm 1.09	18.92 \pm 7.51

Table 3: The normality and homogeneity of the data

The mean Brunnstrom scores in the pre-intervention stage were the same in both groups before the intervention, while they were significantly different post intervention. That is, the mean Brunnstrom score was significantly higher in the intervention group than the control group following the intervention ($P<0.016$). The Eta coefficient test in this study was 0.3 indicating that the effect of physiotherapy plus video games–based therapy was 30% more effective than physiotherapy alone. In other words, the intervention group showed a better performance than the control group by 30%.

The results of the Kolmogorov–Smirnov test for depression scores demonstrated the normality of the data ($P>0.05$), and the Levene's test showed that all data was homogeneous ($P>0.05$; Table 3). The means of depression score in the pre-intervention stage were not significantly different between the groups, whereas they showed a significant difference following the intervention, that is, the depression score in the intervention group was significantly lower than that in the control group ($P<0.028$). The Eta coefficient test in this study was 0.407, showing that the effect of physiotherapy with video games was 40.7% more than physiotherapy alone. In other words, the intervention group had a better performance than the control group by 40.7%.

Discussion

Movement problems after stroke are one of the important factors involved in the incidence of post-stroke depression. The current study compared physiotherapy alone with video game-based therapy plus with physiotherapy for improving movement and depression scores in patients with post-stroke depression.

The obtained results demonstrated that physiotherapy plus video games-based therapy was more effective than physiotherapy alone. The Brunnstrom score was higher while depression score was lower in the intervention group compared to the control group.

Motor disorders is one of the most common consequences of stroke and is the main cause of disability and dependence in daily life activities in these patients (12). Given the growing prevalence of stroke even in those under the age of 60 years and the high risk of depression in these patients due to motor disability, it is necessary to provide appropriate services and evaluate the tests used for the assessment of motor function in stroke patients (13).

A recent study showed that the Brunnstrom recovery stages as a standard method can be used for validating newly developed methods (14, 15). The Brunnstrom system is established on limb muscle spasticity and synergies in patients with motor disabilities. Limb movement is related to decreased muscle spasticity and control over limb synergies (16). Naghdi et al. (17) and Safaz et al. (18) demonstrated that the Brunnstrom recovery stage can be utilized for the estimation of disability in the early stages of stroke. This method is convenient and may be easily applied repeatedly for close follow-up during rehabilitation. However, physiotherapy alone can make treatment sessions boring and prolong the duration of treatment in these patients, which leads to failure to perform the exercises and complete the course of treatment. This may, in turn, increase the risk of depression in patients (19). Therefore, in this study we evaluated the effectiveness of video game-based therapy plus physiotherapy for stroke patients. The results of this study showed that the Brunnstrom score had improved in both groups after treatment.

Incorporation of virtual reality into rehabilitation programs has been useful in various patient groups including those with stroke. Cho et al. reported that cognitive function and daily activity performance were improved in stroke patients who received virtual therapy plus physiotherapy than those who had received physiotherapy alone (20). Lee et al. showed improved balance and daily activity performance in patients with spinal cord injury by using virtual reality training intervention (21). Rahimi Shamaei Monfared used video games to promote balance skills and the maximum force produced by lower extremities and reduce fear of falling in stroke patients. However, they did not find any improvement in the intervention group (22).

Morone et al. found that balance test scores improved in 50 patients with subacute phase stroke after using Wii computer games (23). In a review study, Staiano et al. examined the effect of video games on

physical activity. Most studies yield promising results as to improved physical activity after treatment with video games. In general, video games can be used as a promising tool for balance, rehabilitation, and disease management (24). Cho et al. reported that cognitive function and daily activity were improved after video games therapy in subacute phase stroke patients (25).

The results of this study were in line with the findings of previous studies. The mean Brunnstrom score was the same in both groups before treatment, but after therapy patients receiving video games therapy showed a better performance than the control group by 30%.

Rehabilitation could affect mood and physical recovery in patients with post-stroke depression. However, in conventional clinical exercises, only a small percentage of patients are correctly treated which leads to post-stroke depression in most patients (26). Robinson et al. reported that antidepressants can improve depressive symptoms, but the best rehabilitation methods might prevent depression in these patients (27). Kim et al. demonstrated that functional outcome, rehabilitation results, and quality of life are directly related to post-stroke depression (28). In this study, the mean depression scores were the same in both groups before the intervention, but video game-based therapy plus physiotherapy reduced depression scores by 40.7%. Therefore, video game-based therapy is a suitable method for the treatment of stroke patients and can prevent depression in these patients.

Limitations and Suggestions

This clinical trial study was carried out on a small cohort of stroke patients from Iran; therefore, the obtained data could not be generalized to other populations. Consequently, future studies are suggested to use a larger sample size with a comparative design. Previous studies have only presented data on stroke patients; however, in this study, we evaluated the effect of video game-based therapy on post-stroke depression. This strategy can be used to prevent post-stroke depression and can be of great help in the treatment process of these patients. Therefore, it is suggested to address this issue in future studies.

Conclusion

Our findings demonstrated that the Brunnstrom score improved and depression score decreased after the video game-based therapy. Video game-based therapy plus with routine treatment is effective in improving depression in post-stroke patients. Thus, this therapy might be used to avoid the occurrence of post-stroke depression in these patients.

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