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Original Article

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Effectiveness of Relaxation and Respiratory Exercise on Sleep Quality, Depression and Spasticity in Hemiplegic Stroke Patients: Preliminary Findings

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Abstract

Background: Our study aimed to determine the effect of relaxation and breathing exercises in addition to the treatment procedure on depression level, sleep quality, and spasticity in hemiplegic patients.

Methods: Thirty patients aged 40 - 70 years diagnosed with hemiplegia were included in the study. All patients received the same Bobath exercise 3 days a week for 6 weeks. Patients in group 2 additionally received breathing and relaxation exercises. Sleep quality assessment by Pittsburgh Sleep Quality Index (PUKI), depression by Hospital Anxiety and Depression Scale (HADS), and spasticity by Modified Ashworth Scale (MAS) were used. All assessments were made at baseline and 6 weeks after exercise treatments.

Results: In the intragroup evaluation, significant improvements were found in depression evaluation (HADS), specific parameters of sleep quality evaluations (PUKI), and foot-ankle of spasticity evaluation (MAS) in group 2 ($P < 0.05$). When comparing the groups, group 2 showed a significantly better outcome in the total parameter of sleep quality assessment (PUKI) compared to group 1 ($P < 0.05$). Moreover, in evaluating MAS spasticity, group 2 demonstrated greater significance than group 1 in the shoulder girdle and foot-ankle parameters ($P < 0.05$). On the other hand, there was no significant difference between the two groups in the other parameters ($P < 0.05$).

Conclusions: As a result of this study, breathing and relaxation exercises, in addition to Bobath exercises, could be used to treat stroke to improve sleep quality, depression, and spasticity.

Keywords: Depression; Exercise; Relaxation; Pain

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Introduction

Sleep problems, pain, and depression are common complications in individuals who have had a stroke. Sufficient sleep quality and duration are necessary for the normal functioning of the nervous system. Chronic sleep disorders have been shown to have adverse effects on cognition, memory, and overall human health [1]. Furthermore, sleep problems are associated with fatigue, which is essential as it can impact the rehabilitation phase and functional outcomes [2]. Sleep disorders can be the underlying cause of neurological diseases or harmful symptoms and treatment processes. Research has shown that sleep problems are a risk factor, particularly in neurological conditions such as hemiplegia, multiple sclerosis, and Alzheimer's disease [1].

Post-stroke depression is another condition that affects the functionality of stroke patients and is observed in approximately 40% of cases [3]. Problems such as anxiety and apathy can also be encountered. Although depression is more prevalent in individuals with frontal lobe damage in the left hemisphere, this explanation is unclear. It has been suggested that individuals with pre-stroke emotional problems, more significant neurological deficits, difficulty in daily activities, female gender, aphasia, higher cognitive-mental impairments, and inadequate social support are at a higher risk of developing depression [4]. The occurrence rate of depression in the first, second, and third years after stroke ranges from 14% to 30%. Depression can be observed at different times after stroke, but the highest risk period is within the first year after stroke [5].

Recently, there has been a shift towards exploring new approaches for treating depression and sleep problems. Exercise therapies, including relaxation and breathing exercises, are one such application. Compilation studies related to this subject can be found in the literature [6]. When reviewing the literature, studies on young adults related to sleep quality and stress levels are available. Additionally, previous studies evaluating sleep in stroke patients have suggested that their sleep quality is impaired, affecting their emotional and functional status. However, our literature search did not mention a study specifically examining the effects of relaxation and breathing exercises on sleep quality, depression levels, and spasticity in individuals with hemiplegia. Our study aims to investigate the effects of relaxation and breathing exercises and standard treatment procedures on depression levels, sleep quality, and spasticity in individuals with hemiplegia.

Materials and Methods

A randomized controlled study design was conducted. Our study was approved by the Istanbul Aydin University Clinical Research Ethics Advisory Board at the meeting numbered B.3 0.2.AYD.0.00.00-050.06.04/585, and was registered as a retrospectively registered clinical trial (NCT06084273). The study was conducted in compliance with the ethical standards of the responsible institution on human subjects as well as with the Helsinki Declaration.

Participants

Our study was conducted at the Academic Therapy Special Education and Rehabilitation Center between the ages of 40 and 70 years who applied with a complaint of stroke, and 30 individuals were selected among the patients who volunteered and met the inclusion criteria.

The study included patients who met the following inclusion criteria: having had a stroke at least 6 months ago, having a diagnosis of ischemic stroke, possessing adequate cognitive functions, having no pre-existing sleep problems before the disease, absence of emotional disturbance prior to the disease, voluntary participation in the study, no cardiovascular problems, and having a score of 1, 1+, or 2 according to the Modified Ashworth Scale (MAS).

On the other hand, volunteers were excluded from the study if they had a hemorrhagic stroke caused by malignancy or other organic factors, alcohol or drug addiction, or if they exhibited spasticity, scoring 3 or 4 on the MAS, had a sleep apnea.

Randomization

Stroke patients were randomly assigned to two treatment groups: Bobath exercises and Bobath exercises + relaxation and breathing exercises. Patient allocation to one of the two treatment groups (ratio: 1:1) was randomized using the online randomization web service “Research Randomizer”.

Interventions

All assessments were made at baseline and 6 weeks after exercise treatments. All patients received the same Bobath exercise 3 days a week for 6 weeks. Patients in group 2 additionally received breathing and relaxation exercises.

Bobath exercises

The Bobath approach aims to enhance postural and neuromotor control goal directedly, leading to functional improvement. Our study selected the Bobath 30 exercises from the fundamental exercises to create a program specific to the goal and targeting functionality.

The 10 Bobath exercises performed by all participants in the study are as follows: bridging exercise, latissimus stretch exercise, autoinhibition exercise, dorsiflexion training, sitting balance training, upper extremity weight shifting exercise, lower extremity weight shifting exercise, oblique abdominal strengthening exercise, knee control training, and walking training (Supplementary Material 1, www.neurores.org) [7].

Breathing exercises

The puckered lip breathing exercise aims to prevent the closure of the small airways by creating pressure during expiration. During the exercise, the individual is asked to follow these steps: 1) Breathe calmly and slowly through the nose; 2) Pucker the lips as if whistling or inflating a balloon; 3) Exhale the breath with puckered lips.

It is crucial to maintain a specific breathing pattern during the exercise. The individual should inhale for 4 s and exhale for 8 s, ensuring that the exhalation lasts twice as long as the inhalation. Puckered lip breathing should be practiced in conjunction with diaphragmatic breathing exercises.

The diaphragmatic breathing exercise with the physiotherapist was performed sitting on a chair with a backrest and armrest. During inspiration, the individual was asked to place the passive hand on the chest and the actively participating hand under the rib cage, on the upper part of the abdomen. The physiotherapist places his/her hand on the hand placed under the rib cage, gives a small stimulus to the diaphragm muscle, and asks the person to breathe deeply and slowly through the nose until the count of 4 and to move the hand placed on it actively. During expiration, he/she is asked to pucker his/her lips and exhale all the breath he/she has taken in 8 s in a slow and controlled manner. While exhaling, the hand that takes an active role is asked to move inward. The diaphragmatic breathing exercise was combined with the puckered lip breathing exercise for 20 min. A 1-min rest was allowed after every 5 min of exercise.

Rest intervals were observed during the exercise, and participants were advised to wear comfortable clothing. Imagery techniques were used during the instruction of exercises. Observations were made to ensure the correct execution of the exercises [8].

Relaxation exercises

Progressive muscle relaxation is one of the easiest methods to learn and apply, developed by Jacobson (progressive muscle relaxation technique). It involves voluntarily tensing and relaxing large muscle groups regularly and sequentially. The participant was encouraged to wear comfortable clothing, breathe deeply, and exhale. The technique can be performed in a sitting or lying position. Music can be played to contribute to the participant’s relaxation.

While lying on their back, the participant was asked to inform when they felt comfortable and ready. They were then instructed to focus and become aware of their sensations. Taking a deep breath, they were asked to tense their foot for 10 - 20 s slowly and then exhale while relaxing the foot muscles, continuing deep and slow breathing for 30 - 40 s.

A total of 15 muscle groups were targeted, with one repetition each for each region. The participant was cautioned and monitored to avoid excessive stretching that could cause discomfort or cramping [9].

Outcome measures

Sleep quality assessment

The subjective sleep questionnaire, the Pittsburgh Sleep Quality Index (PUKI), is used to assess individuals' sleep quality, sleep duration, presence of sleep problems, and the severity of sleep problems over the past month. A Turkish validation and reliability study of the questionnaire was conducted by Agargun et al [10]. The scale consists of 19 items and measures seven components of sleep quality: subjective sleep quality (C1), sleep onset latency (C2), sleep duration (C3), habitual sleep efficiency (C4), sleep disturbances (C5), use of sleep medication (C6), and daytime dysfunction (C7). The total PUKI score is obtained by summing the scores of these seven subscales and ranges from 0 to 21. The PUKI total score clearly distinguishes good sleepers (PUKI total score ≤ 5) from poor sleepers (PUKI > 5). The scores of the seven subscales are summed to obtain the total PUKI score, with each subscale ranging from 0 to 3 points. The total PUKI score is calculated within the range of 0 - 21. If the total score is 5 or below, sleep quality is considered "good [11].

Depression assessment

The Hospital Anxiety and Depression Scale (HADS) is a self-assessment scale developed to determine the risk, level, and severity of anxiety and depression in individuals (Zigmond, 1983). Aydemir et al [12] conducted a Turkish validation and reliability study of the scale. It consists of a total of 14 items, each with different scoring. The total scores of the subscales are calculated by summing the scores of the 14 items. Odd-numbered items measure anxiety, while even-numbered items measure depression. According to a study conducted in Turkey, the cut-off score for the anxiety subscale is recorded as 10/11, and for the depression subscale, it is 7/8 [13].

Spasticity assessment

Spasticity is a method used to determine the severity of spasticity. The assessment is based on the subjective rating of the resistance felt by the evaluator during the evaluation. It is divided into six degrees: 0 = normal muscle tone, 1 = slight increase in muscle tone with minimal resistance felt at the end of the range of motion, 1+ = minimal resistance felt in less than half of the range of motion, 2 = more pronounced increase in muscle tone but affected parts can be moved without difficulty, 3 = passive movement is complex and requires significant effort, with a noticeable increase in muscle tone, 4 = affected parts are rigid in flexion and extension, with severe increase in tone [14].

Table 1. Comparison of Demographic Characteristics of Patients

	Group 1 (n = 15), mean ± SD	Group 2 (n = 15), mean ± SD	P[a]
Age (years)	52.06 ± 8.86	57.13 ± 9.29	0.138
Height (m)	1.71 ± 0.09	1.70 ± 0.08	0.759
Weight (kg)	79.73 ± 11.65	78.46 ± 10.86	0.760
BMI (kg/m^2)	27.13 ± 4.15	27.00 ± 2.42	0.915

[a]Independent sample *t*-test. Group 1: Bobath exercises group. Group 2: Bobath exercises, breathing, and relaxation exercises. BMI: body mass index; SD: standard deviation.

Sample size

The sample size was calculated using the power analysis program from the website "Raosoft sample size calculator". Assuming an incidence of hemiplegia of 1% both globally and in our country [15] aiming to detect it with a 95% confidence interval (CI), 90% power, and a significance level of 0.05, a total of 11 hemiplegic participants were included in each group. Considering the possibility of participant attrition (20% dropout rate), 30 voluntary individuals were included in the study.

Statistical analysis

SPSS (Statistical Package for the Social Sciences 22.0) was used for data analysis. Descriptive statistics, including mean, standard deviation (SD), CI, and percentages, were defined in the statistical analysis.

For within-group evaluations, the paired samples *t*-test was used. Independent samples *t*-test was used for between-group comparisons. In all analyses, P values less than 0.05 were considered statistically significant.

Effect size (ES) is the proportion of the total variance in the dependent variable that is accounted for by an independent variable or factor. In our study, ES was calculated using the formula ES = (difference between measurements)/SD of the initial measurement. Numerical values for ES were classified as "small" for 0.20 - 0.50, "medium" for 0.51 - 0.80, and "large" for 0.81 and above, according to Cohen et al [16].

Results

The initial demographic characteristics of the cases were compared in Table 1. Body mass index (BMI) was calculated using height and body weight. No significant differences were found among the groups regarding age, height, weight, and BMI (P > 0.05). The comparison of cases based on gender, marital sta-

Table 2. Distribution of Patients According to Gender, Marital Status and Education Level

	Group 1, n (%)	Group 2, n (%)	Chi-square (P[a])
Gender			
Female	4 (26.6%)	6 (40%)	0.705
Male	11 (73.34%)	9 (60%)	
Marital status			
Married	13 (86.7%)	13 (86.7%)	1.000
Single	2 (13.3%)	2 (13.3%)	
Education level			
Secondary school	4 (26.7%)	2 (13.3%)	0.377
Middle school	7 (46.7%)	6 (40.0%)	
High school	3 (20.0%)	4 (26.7%)	
Undergraduate	1 (6.7%)	3 (20.0%)	

[a]Square test. Group 1: Bobath exercises group. Group 2: Bobath exercises, breathing and relaxation exercises.

tus, and education level is presented in Table 2. There were no significant differences among the groups regarding gender, marital status, and education level (P > 0.05).

Intra-group comparisons

The results of both Bobath exercises and relaxation and breathing exercises, in addition to Bobath exercise groups, are presented here (Tables 3-5). The respiratory and relaxation exercise group, in addition to Bobath exercises, showed significant improvements in the parameters of PUKI daytime dysfunction, sleep disturbance, total score, Hospital Anxiety Depression (HAD) depression, and MAS ankle-foot (P < 0.05) (Tables 3-5).

Between-group comparisons

When evaluating the differences between groups using independent sample *t*-test, group 2 was found to be significantly better than group 1 in terms of the total score parameter in PUKI sleep quality assessment (P < 0.05). In the MAS spasticity assessment, group 2 was also found to be significantly better than group 1 in the shoulder girdle parameter (P < 0.05). Although there were significant within-group differences in some sub-parameters of HADS depression assessment, PUKI, and MAS, no significant difference was found between group 1 and group 2 (P < 0.05) (Tables 3-5).

Discussion

In our study comparing the effects of Bobath exercises, which are the foundation of rehabilitation, with the addition of respiratory and relaxation exercises in individuals aged 40 - 70 diagnosed with a stroke, we hypothesized that the respiratory and relaxation exercises applied in addition to Bobath exercises would result in more positive outcomes in terms of sleep quality, depression, and spasticity, compared to Bobath exercise therapy alone. In our study, the respiratory and relaxation exercise group, in addition to Bobath exercises, showed significant improvements in the parameters of PUKI daytime dysfunction, sleep disturbance, total score, HAD depression, and MAS ankle-foot. When analyzing the differences between the groups, we found a significant difference between the groups in terms of PUKI total score (sleep quality) and MAS shoulder girdle (spasticity). As a result, we concluded that adding respiratory and relaxation exercises to Bobath exercises is more beneficial in terms of sleep quality, depression, and spasticity in individuals with stroke, due to their significant ES, compared to the application of Bobath exercises alone. Depression, sleep disturbances, and spasticity are significant problems in individuals who have had a stroke. Approximately one in four survivors of stroke experience effects similar to anxiety [17]. Various methods have been developed and used to address these problems.

Examples include relaxation interventions such as diaphragmatic breathing (slow, deep breaths), yoga (breath control during body movements), progressive muscle relaxation (alternating stretching and relaxing different muscle groups), and massage therapy (manipulation) [18]. In light of this information, we included diaphragmatic breathing, relaxation, and Bobath exercises in our study. Progressive relaxation exercises, developed by Jacobson in 1920, are still used today. They have been included in treatment programs for individuals with chronic illnesses due to their effectiveness in reducing the effects of stress and anxiety, relieving muscle tension and contractions, and facilitating sleep [14]. One reason for choosing relaxation exercises in our study was their potential to alleviate muscle contractions in individuals with spasticity.

Additionally, when reviewing the literature, it is noted that for an individual to fall asleep, the mechanism in the brainstem needs to be active, and for this mechanism to be active, the muscle tension level needs to decrease. If the muscle tension does not decrease, the wakefulness system in the brainstem is stimulated, making it difficult for the person to fall asleep. Progressive relaxation exercises reduce muscle tension and have been proven to positively affect sleep onset [19]. This is

Table 3. Comparison of PUKI Values of Patients Within and Between Groups

	Pre-exercise, mean ± SD	6 weeks after exercise, mean ± SD	Paired sample *t*-test	In-group change, mean (CI)	Effect size	Independent sample t-test
			P[a]			P[b]
Subjective sleep quality						
Group 1	1.06 ± 1.16	0.86 ± 0.91	0.082	0.20 (0.02 - 0.42)	0.172	0.387
Group 2	0.60 ± 0.91	0.60 ± 0.73	1.000	0.00 (0.20 - 0.20)	0.000	
Sleep latency						
Group 1	2.40 ± 0.50	2.13 ± 0.83	0.41	0.26 (0.06 - 0.59)	0.520	0.141
Group 2	2.66 ± 0.70	1.73 ± 0.59	0.164	0.53 (0.12 - 0.94)	0.757	
Sleep duration						
Group 1	0.33 ± 0.89	0.33 ± 0.89	0.42	0.00 (0.54 - 0.54)	0.37	0.606
Group 2	0.33 ± 0.48	0.20 ± 0.41	0.10	0.13 (0.39 - 0.65)	0.27	
Habitual sleep activity						
Group 1	2.00 ± 1.06	1.86 ± 1.06	0.104	0.13 (0.15 - 0.41)	0.122	0.582
Group 2	2.26 ± 1.03	1.66 ± 0.89	0.163	0.60 (0.19 - 1.00)	0.582	
Sleep disorder						
Group 1	1.20 ± 0.41	1.13 ± 0.51	0.334	0.06 (0.07 - 0.20)	0.146	0.271
Group 2	1.06 ± 0.25	0.93 ± 0.45	0.034*	0.13 (0.06 - 0.32)	0.0520	
Sleep medication						
Group 1	1.06 ± 1.16	0.73 ± 0.88	0.332	0.33 (0.06 - 0.60)	0.284	0.352
Group 2	0.73 ± 0.96	0.46 ± 0.63	0.054	0.26 (0.01 - 0.52)	0.270	
Daytime dysfunction						
Group 1	0.53 ± 0.63	0.53 ± 0.63	0.332	0.33 (0.18 - 0.85)	0.14	0.422
Group 2	0.86 ± 0.74	0.73 ± 0.70	0.04*	0.20 (0.30 - 0.70)	0.17	
PUKI total result						
Group 1	8.60 ± 1.99	8.20 ± 1.56	0.082	0.40 (0.05 - 0.85)	0.201	0.003**
Group 2	7.26 ± 2.71	6.13 ± 1.92	0.03*	1.13 (0.15 - 2.11)	0.416	

[a]Paired sample *t*-test. [b]Independent sample *t*-test. *P < 0.05. **P < 0.01. Group 1: Bobath exercises group. Group 2: Bobath exercises, breathing and relaxation exercises. PUKI: Pittsburgh Sleep Quality Index; SD: standard deviation; CI: confidence interval.

another reason we chose relaxation exercises in our study. In a study comparing individuals with sleep problems who practiced progressive relaxation exercises with those who did not, significant reductions in time awake and positive increases in sleep quality were reported in the exercise group. Similarly, in our study, compared to the group that only received Bobath exercises, the group that received Bobath exercises along with respiratory and relaxation exercises showed a significant decrease in PUKI daytime dysfunction, sleep disturbance, and total score parameters after 6 weeks of exercise program. When evaluating between-group differences, a significant difference was found regarding PUKI total score after 6 weeks of the exercise program.

In a study conducted by Bonnin analyzing sleep-related respiratory disorders in acute lacunar stroke, 69.1% of patients had an apnea-hypopnea index ≥ 10, and 44.1% had an apnea-hypopnea index ≥ 20 [20]. Patients with hemorrhagic stroke were not included in our study. However, the ischemic stroke types of the included patients were not analyzed, and sleep apnea was not questioned with the apnea-hypopnea index. These are also limitations of our study. There is a need for future to study specific stroke groups with larger sample sizes, longer follow-up and using the apnea-hypopnea index.

Akdeniz et al evaluated the sleep quality of stroke patients using the PUKI scale and found a positive correlation between PUKI scores and HADS anxiety and depression scores [21]. Although we did not investigate the relationship between these two measures in our study, sleep disorders, depression, and anxiety are comorbid conditions that can affect stroke. Examining the relationship between these two factors in future studies would be beneficial. Minimum clinically important difference (MCID) for HADS and PUKI in hemiplegic patients has not been investigated. However, when analyzed in different disease groups, the MCID of PUKI was 4.4 points, and HADS was 5.7 points [20]. Although there was a statistically significant difference in favor of group 2 in our study, this difference remained below the MCID for both tests. This may have been due to the short follow-up period and the small number of pa-

Table 4. Comparison of Patients' In-Group and Between-Group HAD Values

	Pre-exercise, mean ± SD	6 weeks after exercise, mean ± SD	Paired sample *t*-test	In-group change, mean (CI)	Effect size	Independent sample *t*-test
			P[a]			P[b]
DHAD depression						
Group 1	9.72 ± 2.37	9.33 ± 2.09	0.164	0.40 (0.18 - 0.98)	0.168	0.196
Group 2	11.20 ± 2.51	10.26 ± 1.75	0.017*	0.93 (0.19 - 1.67)	0.370	
DHAD anxiety						
Group 1	9.13 ± 3.13	8.93 ± 3.03	0.536	0.20 (0.46 - 0.86)	0.063	0.393
Group 2	8.46 ± 2.61	8.06 ± 2.40	0.082	0.40 (0.05 - 0.85)	0.153	

[a]Paired sample *t*-test. [b]Independent sample *t*-test. *P < 0.05. Group 1: Bobath exercise group. Group 2: Bobath exercises, breathing and relaxation exercises. SD: standard deviation; CI: confidence interval; HAD: Hospital Anxiety Depression; HADS: Hospital Anxiety and Depression Scale.

tients.

Our study assessed the effects of relaxation and breathing exercises on spasticity using the MAS scale. Our literature review did not find any studies investigating the effects of relaxation and breathing exercises of the exact nature on spasticity. In our study, the effects of relaxation and breathing exercises in addition to Bobath exercises were compared to a group receiving only Bobath exercises. As a result, the group receiving relaxation and breathing exercises showed significant differences in some parameters of MAS compared to the group receiving only Bobath.

Yoo and colleagues studied incorporating breathing exercises into the treatment program after neurological disorders. They stated that breathing exercises significantly differed in treatments and were preventive for the patient's daily life and potential cardiovascular diseases [22]. These study findings align with the hypothesis of our study. In our study, we aimed to contribute to the positive effects of Bobath exercises, which are the foundation of stroke rehabilitation, by using relaxation and breathing exercises in addition to Bobath exercises. In our

Table 5. Comparison of MAS Values of Patients Within and Between Groups

	Pre-exercise, mean ± SD	6 weeks after exercise, mean ± SD	Paired sample *t*-test	In-group change, mean (CI)	Effect size	Independent sample t-test
			P[a]			P[b]
Shoulder belts						
Group 1	2.66 ± 0.61	2.60 ± 0.73	0.334	0.06 (0.07 - 0.20)	0.098	0.036*
Group 2	2.33 ± 0.48	2.00 ± 0.75	0.19	0.33 (0.06 - 0.60)	0.687	
Dirsek						
Group 1	2.60 ± 0.73	2.33 ± 0.61	0.41	0.26 (0.01 - 0.52)	0.356	0.391
Group 2	2.66 ± 0.72	2.53 ± 0.63	0.164	0.13 (0.06 - 0.32)	0.180	
Hand						
Group 1	3.20 ± 0.77	2.93 ± 0.70	0.42	0.26 (0.01 - 0.52)	0.337	1.000
Group 2	3.73 ± 0.45	2.93 ± 0.59	0.10	0.80 (0.42 - 1.17)	1.777	
Hip belts						
Group 1	2.46 ± 0.74	2.20 ± 0.14	0.104	0.26 (0.06 - 0.59)	0.351	0.764
Group 2	2.26 ± 0.70	2.13 ± 0.16	0.163	0.13 (0.06 - 0.32)	0.185	
Knee						
Group 1	2.40 ± 0.63	2.33 ± 0.48	0.334	0.06 (0.07 - 0.20)	0.095	1.000
Group 2	2.40 ± 0.63	2.33 ± 0.61	0.334	0.06 (0.07 - 0.20)	0.095	
Foot-ankle						
Group 1	3.13 ± 0.51	3.06 ± 0.59	0.332	0.06 (0.07 - 0.20)	0.117	0.042*
Group 2	3.46 ± 0.63	2.46 ± 0.91	0.002*	1.00 (0.44 - 1.55)	1.587	

[a]Paired sample *t*-test. [b]Independent sample *t*-test. *P < 0.05. Group 1: Bobath exercise group. Group 2: Bobath exercises, breathing and relaxation exercises. SD: standard deviation; CI: confidence interval; MAS: Modified Ashworth Scale.

literature review, we have yet to come across any studies using breathing exercises in addition to relaxation exercises in stroke patients, indicating the need for further studies with longer durations and more patients.

A limitation of our study is that the assessment period for both groups was limited to 6 weeks. Therefore, our patient follow-up process is still ongoing to observe the long-term effects of the additional breathing and relaxation exercises alongside Bobath exercises. Increasing the number of cases in future studies will lead to more significant results. The second limitation is the failure to assess joint range of motion, which would have made it more convincing that only spasticity has changed. Studies evaluating the joint range of motion with MAS are needed.

Conclusions

It was determined that the addition of respiratory and relaxation exercises to the Bobath exercise regimen was superior to the Bobath exercise group regarding depression and total score in PUKI. Although there were significant differences among some parameters of MAS values and no significant differences in other parameters, the clinical use of respiratory and relaxation exercise therapy in addition to Bobath exercises was found to have medium and large ES, indicating that it is more beneficial than solely applying Bobath exercises. It can be said that the development and implementation of these treatment programs by physiotherapists in clinical settings and their teaching could contribute to positive developments in treating hemiplegia.

Supplementary Material

Suppl 1. The 10 Bobath exercises performed by all participants in the study.

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Financial Disclosure

No financial support was received at any stage of the study.

Conflict of Interest

The study was conducted by Ahsen Songul Tutar Kizilkan as a master’s thesis at the Graduate Education Institute Physiotherapy and Rehabilitation Department, Istanbul Aydin University. Other authors have none to declare.

Informed Consent

Individuals photographed in the appendix have provided written informed consent to their images appearing in publication. All informed consents were obtained from the patients included in the study for publication.

Author Contributions

Ebru Kaya Mutlu and Hanifegul Taskıran contributed to the study design. Ahsen Songul Tutar Kizilkan performed patient recruitment. Ebru Kaya Mutlu and Derya Azim performed the literature search and wrote the manuscript.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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