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The Benefits of Enhanced Folk Dance Sessions for Stroke Rehabilitation in Terms of Motor Learning

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Keywords
dance, training stroke, dynamic balance, mood

Abstract
Introduction: Stroke is a major burden on individuals as well as the rehabilitation system. Dance training is a possible tool used to influence gait and postural control in stroke survivors.
Objectives: The aim of the study is to assess the benefits of a folk dance enhanced rehabilitation programme on functional outcome measures and to clarify in which aspect it may improve balance and gait parameters.
Material and methods: In this pre-post study 24 chronic stroke patients were enrolled. The patients were divided into the control group (CG) and folk dance training group (DG) on a voluntary basis. The CG received conventional rehabilitation five times a week for 50 minutes, the DG took part in additional folk dance sessions five times a week for 50 minutes besides the conventional rehabilitation. Functional balance and gait parameters, hand function and mood were recorded before and after a three week rehabilitation programme. All data were subjected to analysis of variance and Wilcoxon's matched pairs test.
Results: Both groups improved significantly in each assessed parameter except for the mood of CG after the intervention period. The analysis of variance revealed that in terms of mood, the folk dance enhanced rehabilitation was superior to conventional treatment only. Furthermore, the DG improved significantly in the dynamic characteristics of gait and balance, while the changes in the static balance features and hand function did not reach the level of statistical significance.
Conclusions: The data suggest that a folk dance is a feasible way to complete rehabilitation protocol especially in improving mood and dynamic balance parameters.

INTRODUCTION

Stroke is a major burden on the individual as well as the rehabilitation system since it is the second leading cause of both disability and death worldwide, with the highest burden of the disease shared by low- and middle-income countries[1,2]. Balance impairment is one of the common impairments in patients after stroke, which is related to worse physical impairments, disability and low quality of life. Reliable balance ability after stroke is a prerequisite for regaining the independence of gait and activities of daily living[3]. Evidence supports that dance can be one possible tool in rehabilitation to improve balance as it represents a complex biopsychosocial impact on persons. Dance is an effective way to improve physical, psychosocial and cognitive function for post-stroke persons while also promoting meaningful social relationships within the community[4].

According to the results of a recent scoping review about the impact of dance on stroke rehabilitation, the studies demonstrating dance may facilitate changes in balance and fall risk, encourage confidence, promote comfort with the changed body, increase rehabilitation motivation and facilitate community reintegration[5]. A dance programme designed for chronic stroke patients has shown to be safe and feasible post-stroke[6], and no adverse effects have been reported[7]. Attendance and satisfaction were high and participants perceived walking as well as balance benefits[6]. Dance training (DT) appears to show positive effects on post-stroke body functions[7].

Moreover, dance training seems to positively influence motor learning abilities. Since movement and therefore dance propels hippocampal and cortical oscillations, which increase synaptic plasticity, facili-

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tate enhanced communication between brain areas, and optimise brain functioning throughout adulthood and into old age. It has been proposed that transient coupling between rhythms can guide bidirectional information transfer among these structures and might serve to consolidate memory traces[8].

Through dance, neuronal populations of the brain become highly synchronised, which support rhythmic coordination between different brain regions (e.g. those that support sensory, motor, cognitive or emotional abilities)[9]. According to the results and conclusions of a recent metaanalysis, undertaking structured dance of any genre is equally and occasionally more effective than other types of structured exercise for improving a range of health outcome measures[10].

Csárdás (pronounced CHARH-dash) is a Hungarian Folk Dance art. The core of the dance is the Csárdás step, which is simply a sideways step-close; or, more often, a "double"-step-close-step-pause to one side followed by the same to the other. The other key element is a slow start, gradually accelerating to a frenetic finish. The length of dance and rate of acceleration varies greatly with the dancers. Improvisation is the key, and variety the norm[11].

The steps of the Csárdás during folk dance sessions include multiple rhythmic weight shifts driven by external auditory cues. When a sequential movement is driven by external cues, the premotor area – cerebellar circuits are involved in the organisation of the movement[12].

OBJECTIVES

Although the results in the literature are convincing about the positive effects of dance on gait and balance functions in general, they are heterogeneous concerning the characteristics of dance interventions. Therefore, we have chosen a more targeted dance art as an intervention in order to analyse its specific effects on outcome tests. We have formulated the following research questions:

1. What are the additional effects of a folk dance enhanced rehabilitation programme in comparison with a conventional rehabilitation programme?
2. Are there any specific effects of this programme on functional outcome measures?

MATERIAL AND METHODS

Subjects

A total of 24 people with a history of stroke voluntarily participated in the study, the mean (mean ±*SD*) age of the participants being 65.54±10.76 years and the average number of years after stroke totalling 1.67±1.55. The male/female ratio was 42/58%. The participants took part in a three-week inpatient complex rehabilitation programme which includes physical therapy, occupational therapy, psychotherapy and speech language therapy sessions as part of a conventional rehabilitation programme. Besides this conventional programme, the patients could choose additional folk dance sessions. The inclusion criterion was having a stroke within five years, taking part in the three-week long program, having a Functional Ambulatory Category of at least 3 and having good, acceptable cooperation and patient compliance as well as willingness to participate in the programme.

The exclusion criteria were the following: musculoskeletal conditions, such as pain that interfered with movement, inflammation, endoprosthesis, unstable cardiopulmonary status, severe comorbidities that affect physical fitness and training capacity such as malignant tumours, serious organ and respiratory diseases. All participants provided written informed consent for participation in the trial. The study is in compliance with the principles of the 1964 Declaration of Helsinki. The investigations were approved by the National Institute of Pharmacy and Nutrition and registered under number OGYÉI/41694/2019.

Division into groups

The participants were divided into two groups. One of the groups served as a control (CG, n=12). This group took part in the conventional rehabilitation programme only, where physical therapy was provided five times a week, each session lasting 50 minutes, while the other group (DG, n=12) voluntarily took part in enhanced folk dance sessions (five times a week, 50 minutes) be-

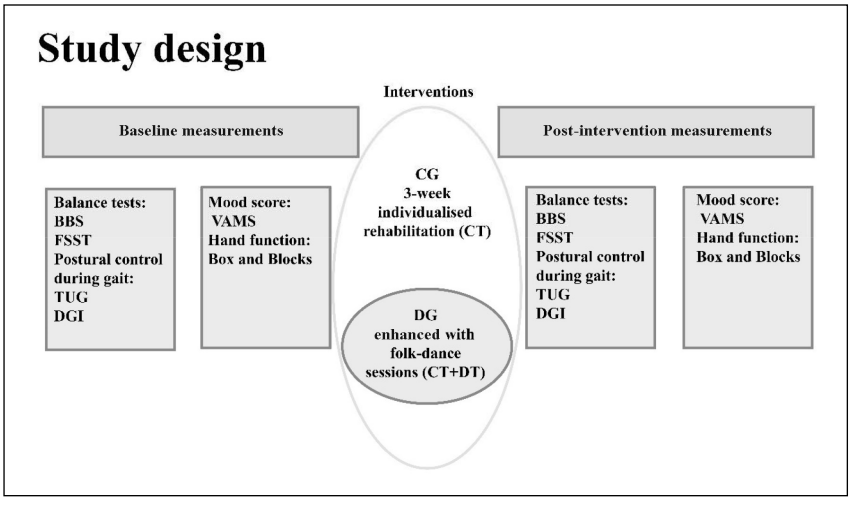

Figure 1

Study design. Flow chart diagram of study design

Abbreviations: DT – Folk dance training, CT – Control/conventional training, DG – Folk dance training group, CG – Control/conventional training group, FSST – Four Square Step Test, TUG – Timed Up and Go, BBS – Berg Balance Scale, DGI – Dynamic Gait index, VAMS – Visual Analogue Mood Scale

sides the conventional programme. A flowchart diagram of the study design can be seen in Figure 1. There were no significant differences between the groups regarding age, BMI and the time following stroke. The mean age of the CG was 65±11.13 years and that of the DG 66.1±11.83 years, while the time after stroke was 1.71±1.62 years for the CG and 1.63±1.55 years in the case of the DG. The male/female ratio was the same in both groups (42/58%).

Interventions

Conventional physical therapy

Both groups had a three-week-long conventional physical therapy training protocol, five times per week, 50 minutes in duration. The members of the CT and DT groups participated in an individualised exercise regimen during the conventional training programme in the physical therapy sessions. The main elements were functional strengthening, improving trunk control, gait, motor coordination, postural control, upper extremity functions and balance.

Dance training

The members of the DT group participated in additional folk dance sessions. During the warm-up period, slow folk music (55 bpm) provided the rhythm for breathing exercises, general mobilisation of cervical spine, trunk and extremities.

The Csárdás sessions were built up gradually and progressively as the patients improved in learning the steps. In different starting positions, e.g. sitting or standing, various rhythm exercises were practiced, creating the rhythm by clapping the hands, tapping with the foot. Circle dance steps were used to enhance cross steps and synchronize the movement with the rhythm of the folk music. Due to the different conditions of the patients, external support was allowed to secure the position while practicing lower limb rhythm components and the initiation of Csárdás steps with slow folk music. We put emphasis on the quality of movement components during performance. Then, a 80 bpm "Füzesi Csárdás" was introduced standing in front of wall bars, offering external support. To introduce more variability, the participants practiced turning steps with the aid of a therapist, if needed. Following, the participants were able to accept faster – 120 bpm folk music, and practice steps at that rhythm. At the end of the session, the cool-down periods were performed in a seated position. The patients received homework. Their task was to memorize the motives, steps and practice mentally.

Outcome measurements

Balance was assessed using the Berg Balance Scale (BBS), which is a reliable measure in the case of stroke[13], and the Four Square Step Test (FSST). The Berg Balance Scale (BBS) is a widely-used assessment tool applied to determine a person's balance abilities. The test contains 14 simple tasks, each of which are scored on a scale from 0 to 4, with higher scores indicating better balance. FSST is an accepted and reliable measurement instrument which also used in stroke rehabilitation to assess dynamic standing balance and coordination, including forward side and backward steps. The test allows to measure the time required to perform the steps[14].

As for postural control during gait, the Timed Up and Go (TUG) test and the Dynamic Gait Index (DGI) were applied; the TUG is a simple test measuring time. It is used to assess a person's mobility and requires both static and dynamic balance[15]. We measured TUG to assess the risk of falling, sit-to-stand, turning and gait for a short distance[16].

Using the DGI, we tested the ability of the participants to maintain walking balance while responding to different task demands, through various dynamic conditions. Tthis outcome measure allows for a maximum of 24 scores[16]. Upper limb function was evaluated with the Box and Blocks (B&B) test measuring the unilateral gross manual dexterity[17]. Mood was assessed via the Visual Analogue Mood Scale (VAMS:0-10).

Data collection and analysis

Data were collected before and after the three-week training interventions during a separate data collection session. All the data were analysed using TIBCO Statistica 14 software. Wilcoxon's matched pairs tests were performed to assess the effect of the applied training types on each outcome measure and to find significant differences. Then, all the data were subjected to analysis of variance (ANOVA) in order to make comparisons between the groups and the effects of the different training methods in terms of functional parameters of the participants. The applied post-hoc test was the Least Significant Difference multiple comparisons test. A 0.05 level of significance was adopted throughout the data analysis.

RESULTS

Descriptive statistics (means and standard deviations (*SD*)) are presented in Table 1. We would like to emphasize the Mood data changed from 5.42±2.47 (mean±*SD*) to 8.50±1.00 in the case of the DG, while from 4.58±2.27 to 5.42±1.73 with regard to the CG.

The results of the single Wilcoxon Matched Pairs tests showed significant improvement ($p=0.03$) in each of the assessed outcome measure parameters for both groups, with the exception of the Mood scale in case of the Control Group. The rehabilitation programme enhanced with folk dance seems to be superior in terms of Mood compared to the conventional programme only (Table 2).

Considering the results of ANOVA, when comparing the two groups in terms of training effects, the amount of improvement did not reach a level of statistical significance in the case of TUG and BBS measures in either of the groups (Figure 2). However, significant improvement was indicated in favour of the DG when analysing the DGI ($p=0.04$) and FSST ($p=0.03$) results, while the changes in the CG were not significant (Figure 3).

Table 1

Descriptive results for each of the analysed variables and for each of the groups included in the study

Variable	Group	Time	Valid N	Mean	Minimum	Maximum	Std. Dev.
FSST	CT	baseline	12.00	24.57	16.01	31.05	4.62
FSST	CT	after	12.00	22.32	13.94	30.08	5.26
FSST	DT	baseline	12.00	27.41	11.70	73.01	17.52
FSST	DT	after	12.00	18.18	7.88	34.76	7.53
TUG	CT	baseline	12.00	25.42	14.96	38.18	6.92
TUG	CT	after	12.00	22.74	13.46	34.25	7.04
TUG	DT	baseline	12.00	24.53	9.02	59.32	13.64
TUG	DT	after	12.00	19.12	7.71	43.10	11.02
B&B	CT	baseline	12.00	13.92	0.00	28.00	10.05
B&B	CT	after	12.00	18.67	0.00	32.00	11.78
B&B	DT	baseline	12.00	19.50	0.00	39.00	14.10
B&B	DT	after	12.00	23.75	2.00	43.00	15.29
BBS	CT	baseline	12.00	35.00	13.00	47.00	11.80
BBS	CT	after	12.00	41.50	30.00	49.00	7.23
BBS	DT	baseline	12.00	39.42	24.00	56.00	9.86
BBS	DT	after	12.00	46.75	25.00	56.00	8.73
DGI	CT	baseline	12.00	13.67	4.00	22.00	6.53
DGI	CT	after	12.00	17.50	12.00	23.00	3.87
DGI	DT	baseline	12.00	13.42	6.00	23.00	4.46
DGI	DT	after	12.00	17.50	7.00	24.00	4.23
MOOD	CT	baseline	12.00	4.58	1.00	8.00	2.27
MOOD	CT	after	12.00	5.42	2.00	8.00	1.73
MOOD	DT	baseline	12.00	5.42	2.00	10.00	2.47
MOOD	DT	after	12.00	8.50	7.00	10.00	1.00

Abbreviations: FSST – Four Square Step Test, TUG – Timed Up and Go, B&B – Box & Blocks test, BBS – Berg Balance Scale, DGI – Dynamic Gait Index, N – Number, DT – Folk dance training, CT – Control/conventional training, Std. Dev. – Standard Deviation

Table 2

Results of Wilcoxon's Matched Pairs test

Control group	Valid N	T	Z	*p*-value
FSST test	12.00	0.00	3.06	**0.002**
TUG test	12.00	0.00	3.0	**0.002**
B&B score	10.00	0.00	2.803	**0.005**
BBS score	11.00	0.00	2.93	**0.003**
DGI	10.00	0.00	2.80	**0.005**
Mood	7.00	4.00	1.69	*0.091*
Folk dance training group	**Valid N**	**T**	**Z**	***p*-value**
FSST test	12.00	0.00	3.06	**0.002**
TUG test	12.00	0.00	3.06	**0.002**
B&B score	11.00	0.00	2.93	**0.003**
BBS score	11.00	0.00	2.93	**0.003**
DGI	10.00	0.00	2.80	**0.005**
Mood	11.00	0.00	2.93	**0.003**

Significant changes are marked in bold.
Abbreviations: FSST – Four Square Step Test, TUG – Timed Up and Go, B&B – Box & Blocks test, BBS – Berg Balance Scale, DGI – Dynamic Gait Index, N – Number, Z – Z-score, T – T-score

The B&B score did significant improvement in either of the groups, nonetheless, the Mood scale reflected significant elevation in mood after the folk dance training and the mood changes were significantly higher in the DG ($p<0.001$) compared to the CG ($p=0.30$) (Figure 4).

DISCUSSION

The main finding of the study is that conventional rehabilitation training completed with folk dance training sessions influenced mood significantly and the conventional rehabilitation programme enhanced with folk dance training seemed to be superior to the conventional programme, but only concerning mood changes. The chronic stroke patients potentially benefited from the additional folk dance sessions, given the

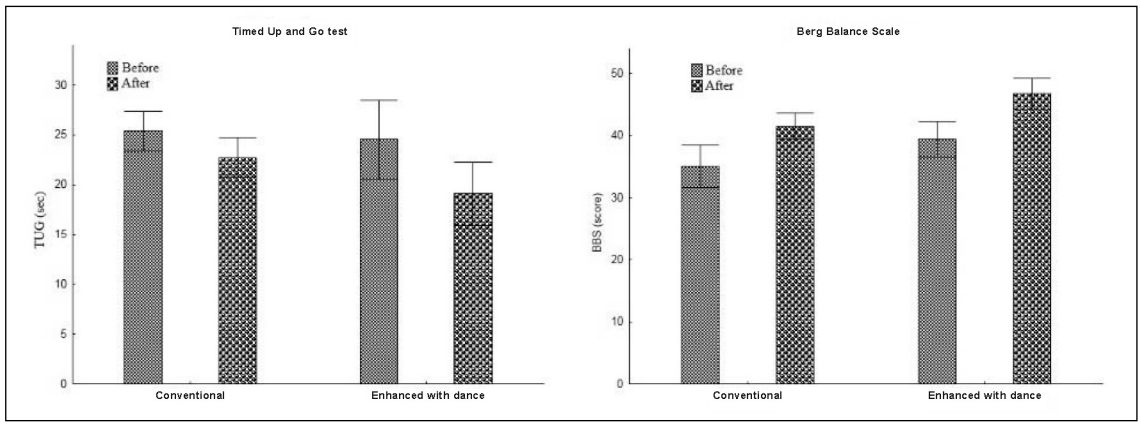

Figure 2

Results of Berg Balance scale and Timed Up and Go test.

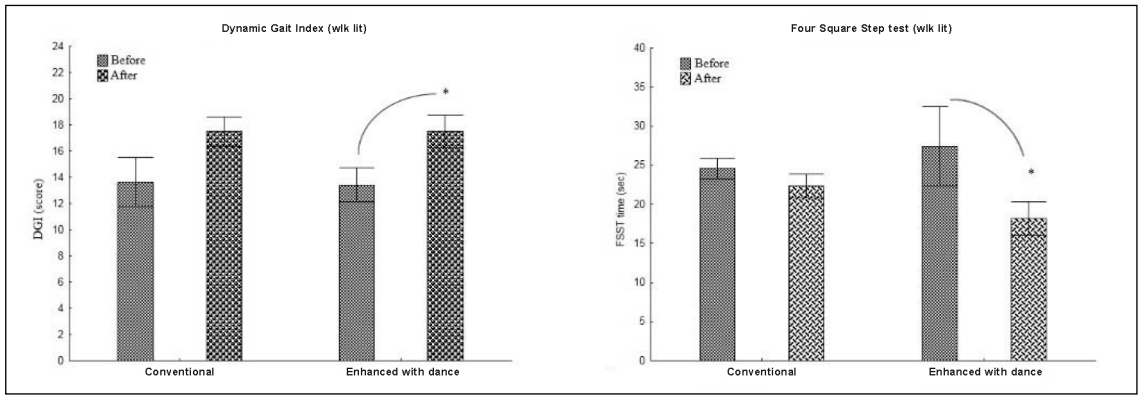

Figure 3

Results of Dynamic Gait Index and Four Square Step test.

Significant changes are marked with an asterisk.

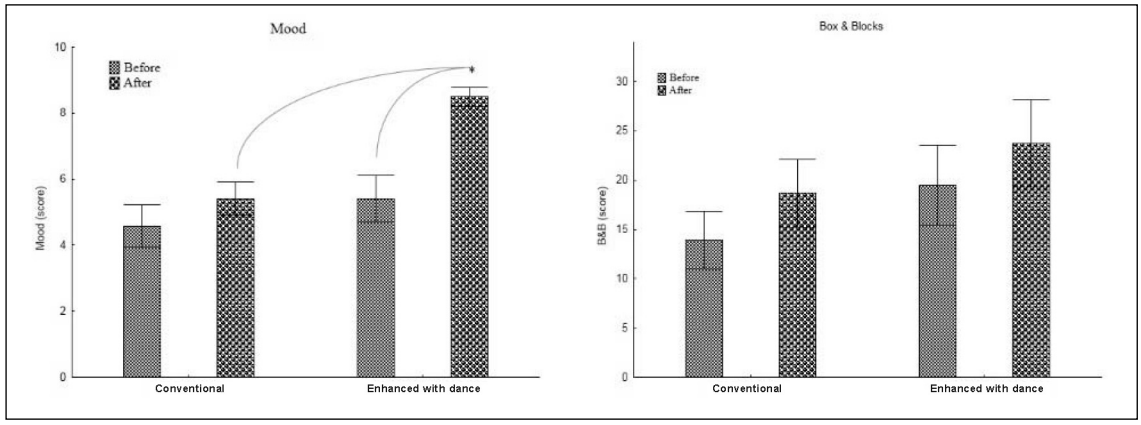

Figure 4

Results of Box & Blocks test and Mood scale.

Significant changes are marked with an asterisk.

fact that many of them suffered from mood changes as a consequence of stroke and evidence suggests that depression is a common experience for stroke survivors[18].

Mood and the limbic system play a role in Postural Control (PC). There is growing evidence stating that posture, in general, influences mood and *vice versa* – as an example, stooped posture did not promote mood recovery as much as straight posture[19]. The embodiment approach to emotion generation proclaims that affective states can occur and be modified as a result of alterations in bodily postures, facial expression or an individual's voice[20], suggesting that upright posture induces positive mood states[21].

Hungarian Folk Dance and Csárdás require upright posture, which by itself, may be capable of positively influencing mood, based on the above mentioned findings[21]. The effects of folk music can reach limbic areas since music as an emotional stimulus, modulates memory and can change mood

as well[22]. In our study, it was not possible to determine the size of the effect on the mood changes in the case of folk music by itself, but we can postulate that folk dance and music together, in a complexity, strongly improved the mood of the participants.

The other important finding of the study is that the rehabilitation programme enhancedwith dance training resulted in stronger improvement in the FSST and DGI scores compared to CT only. These outcome measures are specific to dynamic balance features[14,16].

Movement components of the applied measures and identical elements with folk dance might potentially explain our results. The elements of FSST are quite similar to the steps of Csárdás. In terms of motor learning, this means transfer possibility, since transfer is used to demonstrate whether learning has occurred and if it can be transferred from one situation to another similar one. The DGI contains several dynamic balance components (e.g. step initiations when stepping over or around obstacles and walking on stairs, changes in speed, head movements). From our results, it may be deduced that folk music and folk dance improves the dynamic nature of PC and balance, since it contains dynamic weight shift components. Practicing dynamic weight shifts through Csárdás could be easily transferred to similar situations of FSST or DGI components and can explain the extra benefits of enhanced folk dance sessions expressed in those test results. Therefore, our results support the existing evidence[6,7] noting that chronic stroke patients could benefit from additional folk dance sessions in terms of dynamic balance components.

Static balance conditions were not practiced during dance training and had different underlying neural processing as well as a different perceptual background, and as we found in our earlier study, specific skills could not be transferred even to a situation that was supposedly easier[23]. Thus, physiotherapeutic interventions of this kind should be task-specific as well. The steps of Csárdás offer a task-specific component for dynamic weight shifts, which seems to be beneficial in stroke rehabilitation.

The sub-items of the Berg Balance scale include more static components of balance, thus it may be postulated that this type of folk dance does not affect static balance components as much as the dynamic features presented in DGI or FSST. The TUG test is relevant to movement initiation, gait speed and turning, and folk dance seemed to have no superior effect compared with the CT in this respect. Moreover, our results revealed that the enhanced dance sessions did not influence the hand function any better than CT only. These above-mentioned components were not practiced during the DT either, therefore, the motor learning principles explain well the lack of transfer effects.

The motor control and learning principles can further clarify our results, since our participants learned new dance steps during the folk dance sessions. The theoretical framework called the dynamical systems approach (DSA), increases our understanding of motor control. In recent decades, researchers studying human motor control have attempted to describe the synchronisation of rhythmic movement using DSA. More recently, this approach has been applied specifically to rhythmic dance movements[24].

From the point of view of system theory, movement is an emergent property: it emerges from the interaction of multiple elements that self-organise based on certain dynamic properties of the elements themselves[25]. We postulate that folk music and rhythm may promote the self-organising nature of motor control, even in case of stroke survivors. Music and rhythm can be viewed as forms of sensory cueing. Considering that motor learning is a fundamental process in the rehabilitation of patients with stroke, attentional focus can impact the outcome of the rehabilitation programme.

In previous studies, it has been found that individuals perform and learn motor skills more effectively when they are instructed to adopt an external focus[26]. External focus of attention promotes greater motor learning in the case of adults[27] and focusing attention externally versus internally enhances motor learning and performance[28]. Music and rhythm during folk dance serve as external cues and draw focus of attention and rhythmic cueing already noted as effective in the rehabilitation of Parkinson's Disease[29]. When external cues drive the sequential movement, the premotor area – cerebellar circuits – are more involved in the control of movement[12]. These are excellent alternative pathways to control sequential movements in Parkinson's Disease, in which internal cues are compromised through the supplementary motor area – basal ganglia circuits.

Since external cues can control sequential movement and, in this case, the focus of attention is directed towards external stimuli, the FSST is a great example of when the movement sequence is governed by visual cues during assessment. DGI also contains several items that include external sensory cueing, especially visual (walking over and around obstacles) and auditory commands (when turning and moving the head during gait, changing gait speed and direction on auditory command). Therefore, these two outcome measures – FSST and DGI, turned out to be excellent indicators of the additional benefits of enhanced folk dance sessions in our study. The results may indicate sensitivity of these tests toward external cues and external focus of attention situations.

One limitation of the study is that it was not possible to determine the size of the effect of folk music by itself on significant mood changes since we used a complex folk music and folk dance interventions. Further investigations may reveal the separate effects of music and dance experiences. Moreover, the effects of social interactions should be determined as being, by themselves, possible therapeutic factors. In summary, our study allowed to provide evidence regarding the superior effect of folk dance on mood in the case of stroke survivors. Folk dance training based on Csárdás steps exerted more robust changes in FSST and DGI outcome measures, which might indicate sensitivity of these tests in measuring the benefits of external cuing and external focus of attention situations.

CONCLUSION

In our study the training effects of conventional rehabilitation training and conventional rehabilitation training completed with folk dance training were examined, and based on our results, the following conclusions have been formulated:

1. What are the additional effects of a folk dance augmented rehabilitation programme in comparison with the conventional rehabilitation programme? The data suggest that folk dance is a feasible way to complete the rehabilitation protocol, especially showing benefits in improving mood and dynamic balance parameters.
2. Are there any specific effects of a folk dance enhanced rehabilitation programme on functional outcome measures? As for the outcome measures, the FSST and DGI seemed to be an excellent indicator concerning the extra benefits of enhanced folk dance sessions. The results may indicate sensitivity of these tests towards external cues and external focus of attention situations. Therefore, the conventional rehabilitation training enhanced with folk dance training may be a viable therapeutic approach in the case of chronic stroke patients, utilising the power of folk music and dance in motor learning.

Abbreviations

DT – Folk dance training, CT – Control/conventional training, DG – Folk dance training group, CG – Control/conventional training group, FSST – Four Square Step Test, TUG – Timed Up and Go, B&B – Box & Blocks test, BBS – Berg Balance Scale, DGI – Dynamic Gait index, VAMS – Visual Analogue Mood Scale, PC – Postural Control.

Supporting information

The authors declare no conflict of interest.

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All participants provided their informed written consent. All participants were informed that they could withdraw from the study at any time.

The study is in compliance with the principles of the 1964 Declaration of Helsinki.

The investigations were approved by the National Institute of Pharmacy and Nutrition, registered under the number OGYÉI/41694/2019.

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