Original Article

The effect of Kathak Dance Movement on Balance and Gait in Parkinson's Disease: An Experimental Study

O efeito do movimento de dança Kathak no equilíbrio e marcha na doença de Parkinson: Um estudo experimental

Deepika Metange[1]
Loveleen Waghule[2]
Medha Deo[3]

[1]Corresponding author. Terna Physiotherapy College, Navi Mumbai, Maharashtra, India. deepikapuri12@gmail.com
[2-3]Terna Physiotherapy College, Navi Mumbai, Maharashtra, India. loveleenw28@gmail.com, medhadeoin@yahoo.com

ABSTRACT | INTRODUCTION: Difficulties with gait and balance are common among individuals with Parkinson's disease (PD). Several different exercise programs have been suggested to address balance and gait problems to improve the quality of life and patient compliance with PD exercises. Dance may be an effective tool for addressing these problems because it includes key elements of dynamic balance, can improve functional mobility, and is, at the same time, enjoyable and engaging. **OBJECTIVES:** The purpose of this study was to assess the effect of Kathak dance movement in addition to conventional physiotherapy on balance and gait in Parkinson's disease patients. **METHODS AND MATERIALS:** A total of 44 patients diagnosed with Parkinson's disease were included in the study with a mean age of 63.20 + 8.5 years. Patients were randomly divided into two groups, the control group received conventional physiotherapy, and the experimental group received the same along with Kathak dance movements which were Tatkar and Gatnikas. The intervention was given three days a week for four weeks. Pre- and post-assessment for balance and gait was assessed by scales including TUG test, Tinetti, FOG-Q, and UPDRS-III. The within-group comparison was made using Wilcoxon Signed rank test and between the group using the Mann Whitney U test to see the effect of treatment intervention. **RESULTS:** The mean age of participants for both groups were 64.18±8.53 and 62.23±6.21, respectively. The comparison showed a significant difference in TUG, Tinetti, and FOG-Q within the group with $p<0.01$. The between-group comparison showed no significant difference between the two treatments interventions with $p=0.361$ for TUG, $p=0.479$ for Tinetti, and $p= 0.73$ for FOG-Q. **CONCLUSION**: Both groups showed similar improvements in balance and gait in PD patients. Thus, we conclude that the Kathak Dance movement can be used to complement conventional physical therapy exercises.

KEYWORDS: Balance. Dance movement therapy. Gait. Kathak. Parkinson's disease.

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RESUMO | INTRODUÇÃO: Dificuldades de locomoção e equilíbrio são comuns entre os indivíduos com doença de Parkinson (DP). Vários programas diferentes de exercícios foram sugeridos para tratar de problemas de equilíbrio e de marcha para melhorar a qualidade de vida e a adesão do paciente aos exercícios de DP. A dança pode ser uma ferramenta eficaz para resolver esses problemas porque inclui elementos-chave de equilíbrio dinâmico, pode melhorar a mobilidade funcional e, ao mesmo tempo, é agradável e envolvente. **OBJETIVOS:** O objetivo deste estudo foi avaliar o efeito do movimento de dança Kathak além da fisioterapia convencional no equilíbrio e na marcha em pacientes com doença de Parkinson. **MÉTODOS E MATERIAIS:** Um total de 44 pacientes diagnosticados com Parkinson foram incluídos no estudo com uma idade média de 63,20 + 8,5 anos. Os pacientes foram divididos aleatoriamente em dois grupos, o grupo controle recebeu fisioterapia convencional, e o grupo experimental recebeu o mesmo juntamente com movimentos de dança Kathak que foram Tatkar e Gatnikas. A intervenção foi dada três dias por semana durante quatro semanas. A pré e pós-avaliação para equilíbrio e marcha foi avaliada por escalas incluindo o teste TUG, Tinetti, FOG-Q e UPDRS-III. A comparação dentro do grupo foi feita usando o teste Wilcoxon Signed rank e entre o grupo usando o teste Mann Whitney U para ver o efeito da intervenção de tratamento. **RESULTADOS:** A idade média dos participantes de ambos os grupos foi de 64,18±8,53 e 62,23±6,21, respectivamente. A comparação mostrou uma diferença significativa em TUG, Tinetti, e FOG-Q dentro do grupo com $p<0,01$. A comparação entre grupos não mostrou diferença significativa entre as duas intervenções de tratamento com $p=0,361$ para TUG, $p=0,479$ para Tinetti, e $p= 0,73$ para FOG-Q. **CONCLUSÃO:** Ambos os grupos mostraram melhorias semelhantes no equilíbrio e na marcha de pacientes com DP. Assim, concluímos que o movimento da Dança Kathak pode ser usado para complementar os exercícios de fisioterapia convencional.

PALAVRAS-CHAVE: Equilíbrio. Terapia em dança e movimento. Marcha. Kathak. Doença de Parkinson.

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Introduction

Parkinson's disease (PD) is a progressive nervous system disease. The cardinal features of the disease include rigidity, bradykinesia, tremors, and postural instability.[1] It is the second most common neurodegenerative disorder only after Alzheimer's disease.[2] Being a movement disorder, it affects the ability to perform everyday activities of daily living by involving multiple motor and nonmotor neural circuits.[3] Difficulties with gait and balance are common among individuals with Parkinson's disease, affecting the functional activity and contributing to increased falls.[1] Problem with controlling posture and balance limit independence, community ambulation, and safety.[1] Most patients with gait deficits can compensate at least partially using external cues and attentional strategies.

Exercises have been considered as an effective therapy to traditional pharmacologic treatments. Various exercises have been reported to improve gait and balance in people with PD. Common forms of aerobic exercise reduce overall disease severity, which is reflected by lowering of UPDRS-III scores (Unified Parkinson Disease Rating Scale) and improves the aerobic capacity of patients as well.[4-6]

Researchers have given recommendations regarding key components of exercise programs given the beneficial effects of exercises in patients with PD.[7,8] In order for the exercise program to be effective for patients with PD, four key areas are recommended to be inclusive, which include: 1) cueing strategies to improve gait, 2) cognitive movement strategies to improve transfers, 3) exercises to improve balance, and 4) training of joint mobility and muscle power to improve physical capacity.[7,8] It is critical to develop an exercise program that will incorporate the key elements of exercises and, at the same time, is enjoyable and engaging for the patients. Thus, given these specifications, dance may be an appropriate intervention for individuals with PD.[4] Dance may address each of these areas identified as important for an exercise program designed for individuals with PD.

Kathak is a classical Indian dance form that involves rhythmic Tatkar (footwork), Gatnikas (walking front, back, and sideways), Spins (chakkar), and Bhav (expression). All movements in Kathak are performed in an erect, graceful posture. While doing the footwork, the dancer taps his/her feet on the floor, making a sound, which gives one kind of rhythm to him/her. In gatnikas (chaal) dancer walks front-back and sideways in an erect posture on beats.[9]

Previous research signifies that to improve a particular task, one should practice that same task.[6,10] This concept of task-specific training may be an important aspect of dance as dance incorporates specific movements.[4] People with PD struggle with basic functional movements like walking and turning[11-12], such specific movements can be incorporated with dance practice in the task-specific program. Kathak also includes walking turning movements along with pauses, such that movement initiation is practiced repeatedly throughout the dance. Furthermore, as one must execute the dance steps while simultaneously following the music being played in the background, dance may provide a framework for the practice of multi-tasking.

Thus, the study aimed to assess the effect of Kathak dance movement in addition to conventional physiotherapy on balance and gait in Parkinson's disease patients.

Methods

Study design and participants

A quasi-experimental study was carried out with 44 patients diagnosed with Parkinson's disease. Participants were recruited from the Parkinson Society and the community through consecutive consent sampling[13], and the study was conducted over a total period of 12 months.

Patients included in the study were those diagnosed with idiopathic Parkinson's disease, Hoehn scale and Yahr stage I-III, with MMSE score > 24. Those with other neurological deficits, visual or hearing loss, and cardiorespiratory problems were excluded. All patients were on stable medication regimens and were approached during the "ON" phase (3 hours after PD medication).

The study protocol and procedure were explained to the patients, who then signed an informed consent form. Permission and approval to conduct research were obtained from the institutional ethical committee at Terna Physiotherapy College, Navi Mumbai (TPC/OFF/422). All participants were informed of the benefits and risks of participating before giving their written consent for inclusion.

Procedure

The study protocol and procedure were explained to the participants who signed an informed consent form and met the inclusion criteria. Measurements were performed: pre-test using the Time Up and Go (TUG) test, Tinetti Test (both balance and gait subscale), Freezing of Gait Questionnaire (FOG-Q), and Unified Classification of Parkinson's Disease Scale (UPDRS-III).

The Timed Up & Go (TUG) test is a physical performance measure in which the ability to rise from a seated chair position, walk 3m, turn, walk back, and sit down is timed. This measure is useful in an outpatient setting because it requires only a few minutes, is easy to administer, and requires little equipment. The TUG test correlates with functional mobility, gait speed, and falls in older adults.[14] Specific to PD, longer TUG test times are associated with decreased mobility and may more accurately predict falls than the pull test of the UPDRS.[15] The TUG test is also demonstrated to have a high test-retest reliability and interrater reliability in PD populations.[16] Nocera et al. suggested a proposed cut score of 11.5 seconds for discrimination of those who did or did not fall in PD.[17]

Tinetti is a functional measure of dynamic balance and gait. It has nine balance components and eight gait components completed in 15 minutes. The balance assessment is initiated with the participant seated while performing various activities. The participant walks at their normal pace on a level surface in the gait assessment, and an evaluator grades their gait. Scoring is on a three-point ordinal scale, ranging from 0 to 2. A score of 0 represents the most impairment, while a score of 2 represents independence. The maximum score for the gait and balance components is 12 and 16 points, respectively (maximum total score is 28 points). It is widely used owing to its validity, reliability, sensitivity to change, and predictive validity.[18] Contreras & Grandas,2012 suggested cut-off score for Tinetti Total=17.5, Tinetti-Balance=11.5 and Tinetti-Gait=10.5 points in patients with PD.[19]

Unified Parkinson's Disease Rating Scale (UPDRS) scale consists of the following five segments: 1) Mentation, Behavior, and Mood, 2) ADL, 3) Motor sections, 4) Modified Hoehn and Yahr Scale, and 5) Schwab and England ADL scale. (UPDRS) III is the most widely used measure to assess motor symptoms and signs in Parkinson's disease (PD). The motor section is the only component of the UPDRS where items are scored by the physician rather than by patient self-report. It specifically examines different components of disease severity which includes speech, facial expressions, tremor at rest, action tremors of the hand, rigidity, finger taps, hand movements, rapid alternating movements of the hand, leg agility, arising from a chair, posture, gait, postural stability, body bradykinesia, and hypokinesia. The scale consists of five-category ordinal items scored 0–4. It is a valid and reliable tool for global PD severity and multiple distinct areas of physical disability.[20]

Freezing of Gait Questionnaire (FOGQ) is a clinician/interview administered patient-reported rating scale. The FOGQ consists of six items scored from 0-4. Four of the items assess FOG severity, and two items assess gait. The total score ranges from 0 to 24. Based on a five-point interval scale, higher scores denote more severe FOG. The test has excellent test-retest reliability and validity.[21]

Each patient was assigned a number, after which they were randomly divided into two groups, Group A (control) and Group B (experimental). Patients were blinded about the allocation of the group, and randomization of groups was done by using a random number generator (an application tool in the statistical software, Statistical Package for Social Sciences / IBM SPSS, version 21.0 (IBM Corp)).

The control group underwent physiotherapy exercises[22] for a total of 12 sessions. Each 60-minute session included exercises in sitting position (plastic chair with armrest and backrest) for balance training-arm out to the side, arm folded across chest, clapping arms, weight shifts (anterior-posterior and medial-lateral), and reaching out. In standing position, heel rises and toe offs, partial squats, chair rises, single limb stance with sidekick and back kicks. Other exercises to improve gait impairments included marching bilaterally, PNF activity of braiding each side, changing directions while walking, turning, and negotiating obstacles using external cues.[11] All the exercises were based on KNGF guidelines[7], which identifies five core areas for exercises in PD patients. This includes transfers, body posture, reaching and grasping, balance, and gait. Exercises were individualized for each subject based on specific impairments and subject goals and included but not limited to the items mentioned above.[23]

The experimental group performed the same exercise program and additional movements to this Kathak dance, including Tatkar (footwork) and Gatnikas/ chaal (walking forward, backward, and side to side). Each individual session for both groups was designed to last 60 minutes per session, which continued for three sessions per week for four weeks. All training sessions were individually delivered to patients and conducted by an instructor who was a certified professional physiotherapist and a trained Kathak dancer. Subjects were instructed not to initiate any new exercise regimens during the study. Post-treatment measurements were performed with the same outcome measures.

Statistical Consideration

Data were subjected to statistical analysis using the Statistical Package for Social Sciences (SPSS v 21.0, IBM). For all statistical tests, $p < 0.05$ was statistically significant, keeping the α error at 5% and the β error at 20%, giving the study a power of 80%. A pre-test comparison was made for both groups, showing no statistically significant difference; therefore, both groups were comparable at baseline.

Results were expressed as means (± SD). Absolute and relative frequencies were described for categorical variables. When indicated (categorical variables), comparisons between sociodemographic and clinical characteristics were performed using the $\chi 2$ test or Fisher's exact test when indicated (categorical variables). Moreover, the numerical variables were compared using the Student's Independent Test. Within group comparison was made using the Wilcoxon signed-rank test, and the between-group comparison was made using the Mann-Whitney U test to observe the effect of the treatment intervention.

Results

Figure 1. The final sample consisted of 44 patients. The sample was divided into Group A (control) and Group: B (experimental) (Institucional Ethical Committee)

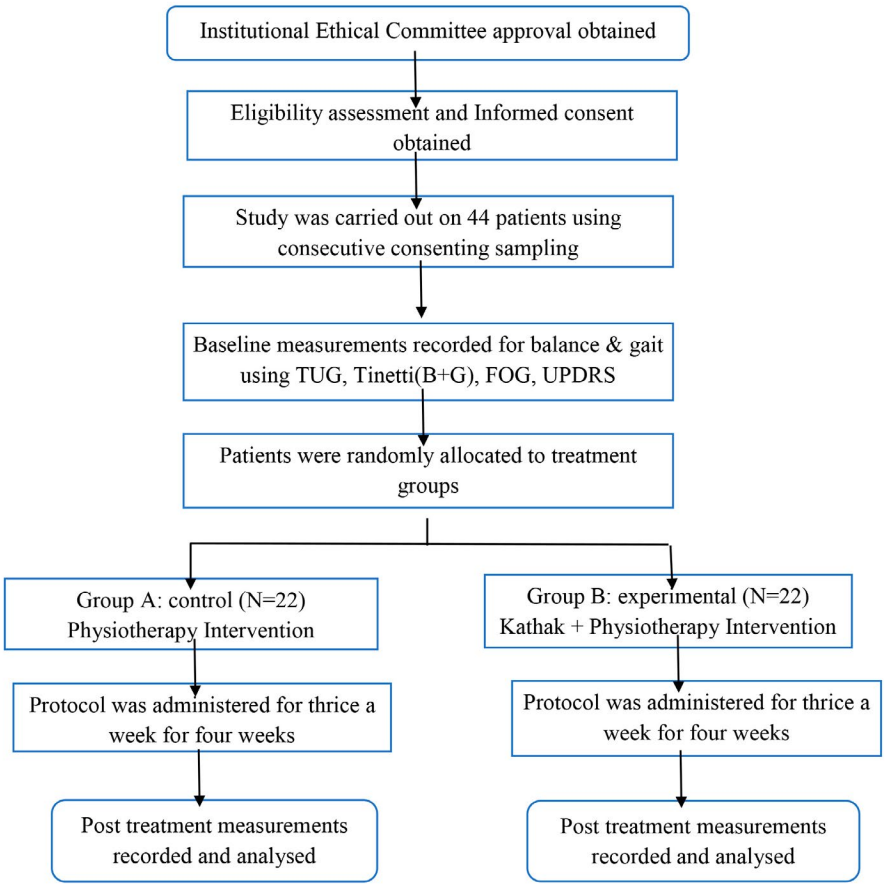


Table 1 shows the comparison of sociodemographic and clinical characteristics of the participants between the groups (control and experimental). As the sample size is small, heterogeneity is present in the analyzed variables ($p > 0.05$), increasing the chances of false-positive results.

Table 1. Sociodemographic and clinical characteristics of 44 patients with Parkinson's Disease

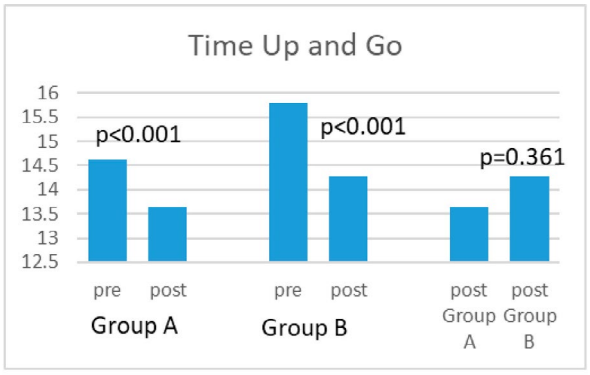
Characteristics	Group A (M±SD)	Group B (M±SD)	p- value
Gender N%	N=22	N=22	
Male	14 (64%)	45%	0.112*
Female	36%	55%	
Age (M±SD)	64.18±8.53	62.23±6.21	0.390**
Years since PD diagnosis	3.42±2.28	4.74±3.62	0.155**
Hoehn and Yahr scale (M±SD)	1.76±0.83	1.58±0.68	0.435**
MMSE (M±SD)	25.11±1.36	24.76±1.62	0.442**
Gait Freezing (N%)	18.18%	22.72%	0.354**
Duration of previous physiotherapy treatment (Months)	8.62±1.61	7.51±2.37	0.076**
Marital Status N (%)			
Married	89%	91%	0.420*
Widowed	11%	9%	

*Student's Independent Test, **Chi-square test/Fisher's exact test.

Time up and Go

In the within-group comparison for the TUG test for the control and experimental groups, there was a statistically significant difference for the values ($p < 0.01$). However, when comparing the post-intervention values between the control and experiment groups, there was no significant difference ($p = 0.361$), (Figure 2).

Figure 2. Comparison of TUG values between control and experimental groups patients with Parkinson's Disease, N:44

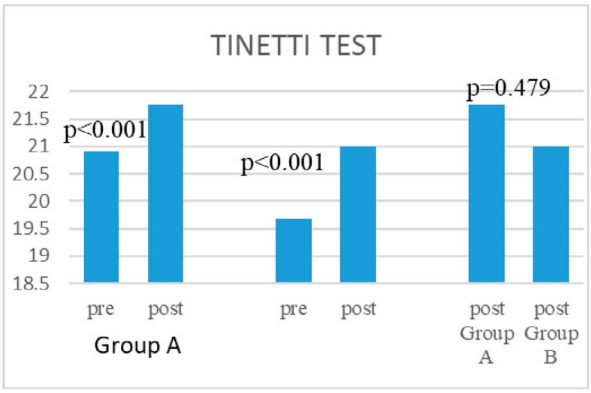


Group A: control; Group B: Experiment.

Tinetti Test

Both groups showed a statistically significant difference after the intervention with $p < 0.001$. However, the comparison between groups produced no significant difference after the intervention, $p = 0.479$ (Figure 3).

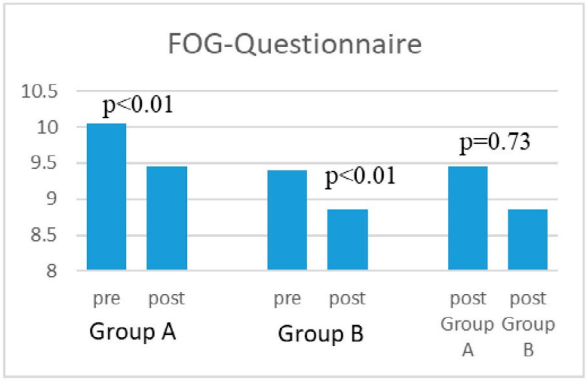
Figure 3. Comparison of Tinetti Test values between control and experimental groups of patients with Parkinson's disease, N:44



Freezing of Gait Questionnaire

There was a significant difference seen for Freezing of Gait questionnaire for both the groups post intervention with p<0.01. Between groups, there was no significant change in perception of freezing for either of the groups post intervention with p=0.73 (Figure 4). However, both groups showed trends toward a reduction in reported freezing.

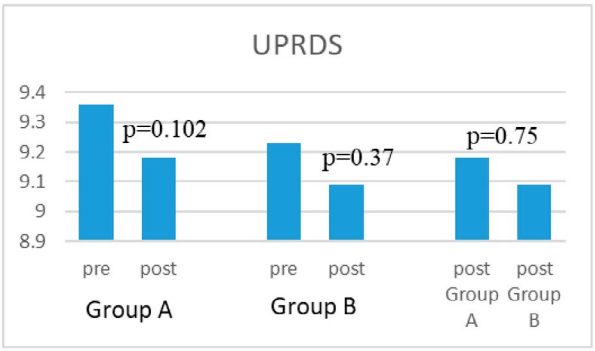
Figure 4. Comparison of FOG -Questionnaire values between control and experimental groups of patients with Parkinson's disease, N:44



Unified Parkinson's Disease Rating Scale III- UPDRS

There was no statistical difference when analyzing the UPDRS values in the researched sample, p>0.05, (Figure 5).

Figure 5. Comparison of UPDRS values between control and experimental groups of patients with Parkinson's disease, N: 44



Discussion

Individuals with PD may present balance and gait problems that reduce their mobility in activities of daily living.[1,24,25] Dance has been used as an exercise in this population.[4] Comparison of each group pre and post shows that balance and mobility results improved in both groups. This improvement may have been due to physical therapy alone, as it is the only therapy present in both groups, and dance may not have made a difference. Although the results were not significant, dance can be an interesting alternative to be added to physiotherapy as playful work and socio-cultural interaction. The lack of significance may be due to the small sample size, heterogeneity of baseline sociodemographic and clinical values, and the short treatment period.

In the present study, balance and gait were assessed by Tinetti, TUG test, FOG-Q. UPDRS III scale was used to gauge the severity and progression of Parkinson's disease. The minimal detectable change (MDC) for the timed up and go test[16] in PD patients is 3.5 s, higher than the 1 s improvement observed in the control group and 1.6 s in the experimental group. The minimum detectable change in the UPDRS III scale, a value of 5, is considered significant.[26] In the present study, there was no significant change in any group. Data on MDC for Tinetti and FOG-Q in PD patients is lacking. In a study, Deb A Kegelmeyer et al. concluded that Tinetti is a better predictor of fall risk in individuals with PD than several other clinical balance tests.[27]

The results displayed significant improvement after the intervention within groups. However, it is not clear if the difference is clinically meaningful as results did not display any significant difference on most measures of functional mobility (clinical tests) above the reported threshold for MDC. Also, UPDRSIII showed no effect in within or between-group comparison. This could be explained owing to the greater sensitivity of functional and objective measures than the more subjective UPDRSIII in capturing changes in motor performance.[23]

No significant effect in the intervention group may be explained as dance styles are incorporated into balance exercises as a part of exercise protocol, such as placing one foot in front, dynamic balance in single stance, heel-toe, and toe-heel walking. Also, the long-term effect of intervention in future studies with a large sample size may be helpful to see if the changes observed in balance and gait can be above the minimal detectable change. Though not evaluated, the patients' adherence to treatment with Kathak was good and encouraging. Since the patient has a sense of learning a new thing, thus physiotherapy exercise using dance as an adjunct could be more compliant and beneficial.

In the clinical literature, sensory systems through visual or auditory cues have been mentioned as a form of non-pharmacological treatment to facilitate locomotor activity.[28-29] The cues can improve gait in people with PD.[28] They are defined as the use of external temporals or spatial stimuli to facilitate onset and continuation of movement (walking).[29] Recent reviews suggest that it may immediately affect gait performance in people with Parkinson's disease.[30] In the present study these stimuli were provided through physical therapy interventions and Kathak dance movements.

Recent research has indicated the use of rhythmic auditory cueing and exercise owing to the positive effects it has proven for gait and mobility in patients with PD.[31] Thus, it is suggested to be incorporated into a regular rehabilitation program for such patients.[31] Studies carried out to demonstrate the effectiveness of gait training assisted by rhythmic auditory stimulation has demonstrated an overall improvement in gait quality.[32] Alongside, improvements in speed and stride length and regularizing of cadence were also demonstrated.[32]

Though both treatment groups had a notable change in TUG scores post-treatment, clinically meaningful results were not found. Previous research reporting overall gait improvement has used more objective measures like kinematic gait parameters and gait analysis. However, they were not used in the present study.

Moreover, PD is recognized as a complex condition with an individualized presentation.[33] Therefore, Morris and colleagues emphasized the importance of physiotherapists to understand the specific experience of Parkinson's disease by the individual patient.[34] They emphasized that treatment should be tailor-made to suit a person's complaints, lifestyle, and personal interests instead of a "one size fit all" approach.[34]

The developing evidence is suggestive that the structures (basal ganglia) affected by PD are particularly involved in the control of dance movements. Brown et al. used Positron Emission Tomography to study the brain regions involved in the control of tango movements of a single lower extremity in healthy subjects lying supine.[12] They examined three core aspects of dance in their study: entrainment, meter, and patterned movement. In their study, amateur dancers were made to perform small-scale, cyclically repeated tango steps on an inclined surface without any visual guidance. Their study demonstrated that entrainment of dance steps to music was supported by anterior cerebellar vermis compared to self-pacing movements. In the voluntary control of metric motion, movement to a regular metric rhythm was supported by the right putamen in comparison to movement to an irregular rhythm. The medial superior parietal lobule was activated with spatial navigation of leg movement during the dance. This contributes to the proprioceptive and somatosensory contributions to spatial cognition in dance. They concluded that cortical, subcortical, and cerebellar regions were active at the systems level. The data from their study concludes that the interacting network of brain areas during spatially patterned, bipedal, rhythmic movements are integrated with dance. This is also consistent with recent work on simpler and rhythmic, motor-sensory behaviors.[12] It may be interesting to carry out a similar study for individuals with Parkinson's applying Kathak in future research.

The present study has some limitations: evaluators were not blinded to group allocation, possible participants who presented frozen gait as an outcome modifier, physical activity, or other modalities of physical therapy performed previously. Furthermore, PD H&Y III stages and cognitive dysfunction might have influenced the results of this study. Though subjects were instructed not to begin any new exercise regime during the study, this factor was not controlled, which could have added a bias in the study. Due to these limitations, the findings must be interpreted cautiously. Future studies should seek to control these potential sources of bias and include a follow-up of the outcome.

Conclusion

From the results obtained, it can be concluded that the Kathak dance movement may be used as a complementary therapy along with routine physiotherapy to improve balance and gait in patients with PD. It can be an interesting alternative to be added to physiotherapy as playful work and socio-cultural interaction and may be an appropriate and effective form of adjunct to exercise for individuals with PD. The patient may also have a sense of learning a new thing; thus, exercises using dance as an adjunct therapy to routine exercise sessions could be more compliant and beneficial.

Authors' contributions

Deepika M and Loveleen W conceptualized and designed the experiment, analyzed, interpreted the data, and wrote the manuscript. Loveleen W collected the data. Deepika M, Loveleen W, and Medha D reviewed and finalized the manuscript for publication. Medha D provided critical intellectual content.

Conflicts of interest

No financial, legal, or political conflicts involving third parties (government, corporations, private foundations, etc.) have been declared for any aspect of the submitted work (including, but not limited to grants and funding, advisory board participation, study design, preparation of the manuscript, statistical analysis, etc.).

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