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Critically Appraised Paper for “Effects of dance on motor functions, cognitive functions, and mental symptoms of Parkinson’s disease: A quasi-randomized pilot trial”

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Evidence Exchange

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CRITICALLY APPRAISED PAPER (CAP)

Hashimoto, H., Takabatake, S., Miyaguchi, H., Nakanishi, H., & Naitou, Y. (2015). Effects of dance on motor functions, cognitive functions, and mental symptoms of Parkinson's disease: A quasi-randomized pilot trial. *Complementary Therapies in Medicine, 23*(2), 210–219. https://doi.org/10.1016/j.ctim.2015.01.010

CLINICAL BOTTOM LINE

Parkinson's disease (PD) is a systemic condition that presents not only motor but also nonmotor symptoms, as a result of dopamine deficiency in the basal ganglia. Rehabilitation typically focuses on motor deficits, however, despite the fact that nonmotor symptoms have a significant impact on quality of life. The researchers of this study investigated the effectiveness of dance on motor functions, cognitive functions, and mental symptoms of individuals with PD. They chose dance as their intervention because it has been shown to activate the basal ganglia as well as improve mood. In addition to motor function and mood, the researchers also assessed the mental symptoms of motivation, depression, and apathy, which are commonly affected by PD.

Forty-six participants were randomized into one of three groups: dance, PD exercise, and control. The dance group used movements that typically are difficult for PD patients, such as simplifying complex movements, using body awareness, and following visual and auditory cues. The PD exercise group participated in physical therapy and exercises. Both the dance and the PD exercise groups met once per week for 12 weeks. The control group participants received no intervention and continued with their normal life activities.

The results of the study indicate that dance may be an effective multifaceted intervention for individuals with PD. The dance intervention required participants to stretch muscles, maintain balance, and perform complex steps. It also might have improved mood and relieved anxiety and depression. Moreover, it might have facilitated meaningful social interactions through increased positive feelings, such as belonging and unity, among participants who shared the same condition. This suggests that dance may be most effective when done in a group. Dance may also increase motivation by activating the basal ganglia network and reward systems of the brain. Last, dance may improve cognitive functioning by facilitating the use of mental imagery to execute dance moves.

The use of a quasi-randomized, between-groups study limits the generalizability of the results

to a larger population and threatens the internal validity of the study. Further threats to internal validity include possible practice effects from two of the assessments, the Frontal Assessment Battery and Hand Mental Rotation Task, as well as recall bias from the Self-Rating Depression Scale, Apathy Scale, and Unified Parkinson's Disease Rating Scale.

Traditionally, motor symptoms have been the target of occupational therapy interventions for persons with PD. Alternatively, the dance-based intervention offers a holistic approach, because it addresses cognitive and psychosocial factors in addition to motor symptoms. The evidence from this study can be used to guide occupational therapy practice by offering dance as an alternative intervention that is both engaging and meaningful. It addresses multiple client factors and thus significantly improves clients' quality of life. Moreover, this study also implies that interventions addressing both motor and nonmotor symptoms may minimize the risk of falls, social isolation, and depression and maximize functional participation in daily life.

RESEARCH OBJECTIVE(S)

Examine the effectiveness of dance on motor functions (balance and walking), cognitive functions (executive functioning, memory, attention, and motor imagery), and mental symptoms (apathy and depression) among persons with PD

DESIGN TYPE AND LEVEL OF EVIDENCE

Level I: Quasi-randomized design

PARTICIPANT SELECTION

How were participants recruited and selected to participate?

Members of six local PD patient associations were invited to participate in the study. The authors held explanatory meetings in the six associations to secure participants for the study. A total of 59 participants agreed to participate and were randomly assigned to one of two intervention groups or to a control group by a study collaborator who was unaware of the study's objectives.

Inclusion criteria:

Participants had a diagnosis of PD, lived at home and received outpatient treatment, were capable of walking independently and tolerating physical activity and dance for 1 hour, and were able to provide consent to participate in the 3-month study.

Exclusion criteria:

NR

PARTICIPANT CHARACTERISTICS

N= **46**

#/ % Male: 12/26% **#/ % Female:** 34/74%

Ethnicity:	The researchers failed to report the ethnicity of the participants; the study took place in Japan, however.
Disease/disability diagnosis:	Participants were mild–moderate PD patients who were living at home and receiving outpatient treatment.

INTERVENTION AND CONTROL GROUPS

Group 1: Dance group

Brief description of the intervention	Participants in the dance group participated in a weekly session at a community hall. Sessions included a warm-up (20 minutes), the main lesson (35 minutes), and relaxation (5 minutes). Dance movements included strategies typically used for patients coping with difficult movements, such as simplifying complex movements, maintaining body awareness, and using visual and audio cues. Specific strategies involved imagining movements; focusing on moving body parts or movements; using visual, auditory, or other sensory stimuli as clues; and repeating combined movements. The authors designed the dances with techniques from modern dance, jazz, tango, and classical ballet to incorporate the strategies listed above. Dance movements included side steps, box steps, various walking speeds, and balancing while shifting the center of gravity in all directions. All of the dance movements could be performed sitting or standing. Participants could also choose to dance alone, in pairs, or in a group.
How many participants in the group?	15 participants
Where did the intervention take place?	Community halls in different regions in Japan
Who delivered?	NR
How often?	One 60-minute session per week
For how long?	12 weeks

Group 2: PD exercise group

Brief description of the intervention	Participants in the PD exercise group participated in sessions at a community hall. Sessions included a warm-up (20 minutes), the main lesson (35 minutes), and relaxation (5 minutes). Exercises included physical therapy and exercises provided by a book or a video, and they incorporated exercising range of motion, maintaining balance, shifting the center of gravity, walking on a

	spot, standing up and sitting down on a chair, and walking along a 7-meter line while counting.
How many participants in the group?	17 participants
Where did the intervention take place?	Community halls in different regions in Japan
Who delivered?	NR
How often?	One 60-minute session per week
For how long?	12 weeks

Group 3: Control group

Brief description of the intervention	Participants in the control group received no intervention. Their only participation in the study consisted of taking the pre- and posttests and continuing with their normal life activities.
How many participants in the group?	14 participants
Where did the intervention take place?	N/A
Who delivered?	N/A
How often?	N/A
For how long?	N/A

INTERVENTION BIASES

Contamination:

YES ☒ NO ☐	*Explanation:* Contamination could have happened, because all participants were members of the same PD associations. In addition, it is possible that there was contamination between the dance group and the PD exercise group, because the interventions took place across multiple community centers. The researchers did not state whether these interventions occurred at separate locations. The researchers also did not state whether participants in the PD and the control groups were permitted to participate in dancing during the 12-week study.

Co-intervention:

YES ☒ NO ☐	*Explanation:* If participants changed the medication that they were using over the course of the study, then they were excluded from analysis. It is possible, however, that these participants were receiving other interventions, such as other forms of therapy, throughout the course of the 12-week intervention.

Timing of intervention:

YES ☐ NO ☒	*Explanation:* The full length of the study was 14 weeks, which included 12 weeks of intervention. Three and a half months should be an adequate amount of time to show change.

Site of intervention:

YES ☒ NO ☐	*Explanation:* Multiple sites were used for the dance and PD exercise groups across different regions in Japan.

Use of different therapists to provide intervention:

YES ☐ NO ☒	*Explanation:* The researchers agreed on and followed the structure and content of both the dance and the PD exercise interventions. The article did not state who implemented the lessons in the dance and the exercise groups in the different regions of Japan where the classes were held.

Baseline equality:

YES ☒ NO ☐	*Explanation:* No significant intergroup differences were found for age, disease duration, or the pretest measurements. There was a significant difference in the male–female ratio, however. The control group had significantly more women than men.

MEASURES AND OUTCOMES

Measure 1: Timed Up-and-Go Test

Name/type of measure used:	Timed Up-and-Go Test (TUG)		
What outcome is measured?	This measure assesses mobility, dynamic balance, walking ability, and fall risk among older adults. The outcome measure is determined by the amount of time and number of steps required to complete the assessment.		
Is the measure reliable (as reported in the article)?	YES ☐	NO ☐	Not Reported ☒
Is the measure valid (as reported in the article)?	YES ☐	NO ☐	Not Reported ☒
When is the measure used?	During the pretest, 1 week prior to the beginning ofthe intervention, and during the posttest, within 1 week after the intervention was completed		

Measure 2: Berg Balance Scale

Name/type of measure used:	Berg Balance Scale (BBS)		
What outcome is measured?	Various aspects of balance, such as weight shifting, suspension, limit of stability, and base of support		
Is the measure	YES ☐	NO ☐	Not Reported ☒

reliable as reported in the article?	
Is the measure valid as reported in the article?	YES ☐ NO ☐ Not Reported ☒
When is the measure used?	During the pretest, 1 week prior to the beginning of the intervention, and during the posttest, within 1 week after the intervention was completed

Measure 3: Frontal Assessment Battery at Bedside

Name/type of measure used:	Frontal Assessment Battery at Bedside (FAB)
What outcome is measured?	Action planning, motor execution, and attention
Is the measure reliable as reported in the article?	YES ☐ NO ☐ Not Reported ☒
Is the measure valid as reported in the article?	YES ☐ NO ☐ Not Reported ☒
When is the measure used?	During the pretest, 1 week prior to the start of the intervention, and during the posttest, within 1 week after the intervention was completed

Measure 4: Hand Mental Rotation Task

Name/type of measure used:	Hand Mental Rotation Task (MRT)
What outcome is measured?	Motor imagery ability
Is the measure reliable as reported in the article?	YES ☐ NO ☐ Not Reported ☒
Is the measure valid as reported in the article?	YES ☐ NO ☐ Not Reported ☒
When is the measure used?	During the pretest, 1 week prior to the start of the intervention, and during the posttest, within 1 week after the intervention was completed

Measure 5: Self-Rating Depression Scale

Name/type of measure used:	Self-Rating Depression Scale (SDS)
What outcome is measured?	Mental symptoms
Is the measure reliable as reported	YES ☐ NO ☐ Not Reported ☒

in the article?	
Is the measure valid as reported in the article?	YES ☐ NO ☐ Not Reported ☒
When is the measure used?	During the pretest, 1 week prior to the start of the intervention, and during the posttest, within 1 week after the intervention was completed

Measure 6: Apathy Scale

Name/type of measure used:	Apathy Scale (AS)
What outcome is measured?	Mental symptoms
Is the measure reliable as reported in the article?	YES ☐ NO ☐ Not Reported ☒
Is the measure valid as reported in the article?	YES ☐ NO ☐ Not Reported ☒
When is the measure used?	During the pretest, 1 week prior to the start of the intervention, and during the posttest, within 1 week after the intervention was completed

Measure 7: Unified Parkinson's Disease Rating Scale

Name/type of measure used:	Unified Parkinson's Disease Rating Scale (UPDRS)
What outcome is measured?	PD symptoms
Is the measure reliable as reported in the article?	YES ☐ NO ☐ Not Reported ☒
Is the measure valid as reported in the article?	YES ☐ NO ☐ Not Reported ☒
When is the measure used?	During the pretest, 1 week prior to the start of the intervention, and during the posttest, within 1 week after the intervention was completed

MEASUREMENT BIASES

Were the evaluators blind to treatment status?

YES ☒ NO ☐	*Explanation:* The five occupational therapists who administered all the pre- and posttest assessments did not know which group the participants belonged to.

Was there recall or memory bias?

YES ☒	*Explanation:* The MRT and the FAB could have had practice effects from

NO ☐	the posttest. The SDS, AS, and UPDRS include subjective reports, which might have been subject to recall bias by the participants of the study.

Other measurement biases:

NR

RESULTS

List key findings based on study objectives:

Motor Functioning

The dance group had significant differences before and after intervention: TUG time, $t(14) = 3.29$, $p < .05$, and step number, $t(14) = 3.29$, $p < .05$, and BBS, $t(14) = -4.27$, $p < .05$, compared with baseline. Overall, the dance group exhibited greater stride width and improved balance and stability. The PD exercise group also showed significant improvement in TUG time, $t(16) = 3.64$, $p < .05$, and step number, $t(16) = 2.82$, $p < .05$, but not BBS. In the control group, only the TUG time showed significant improvement, $t(13) = 2.38$, $p < .05$; step number and BBS remained unchanged. These results suggest that dance, unlike general exercise, can help combat the gait and balance difficulties that are characteristic of PD.

Cognitive Functioning and Mental Symptoms

For the dance group, significant improvements in FAB scores, $t(14) = -4.47$, $p < .05$, and MRT scores, $t(14) = 4.74$, $p < .05$, suggest that frontal lobe function improved and the time needed to generate motor imagery decreased, without any change in number of correct answers. Scores on tests for apathy and depression improved for the dance group—$t(14) = 4.675$, $p < .05$; $t(14) = 3.248$, $p < .05$, respectively—but not for the control group or exercise group. This suggests that dance, unlike exercise, may help to improve psychosocial aspects of PD, such as depression.

General Symptoms of PD

Only the dance group exhibited a significant increase in UPDRS scores, $t(14) = 6.915$, $p < .05$. The exercise group did not have a significant difference in UPDRS scores, and the control group showed a significant decrease in UPDRS scores. This suggests that dance may decrease general symptoms of PD, whereas symptoms increase with other interventions.

Intergroup Comparison

The authors compared the effect of the interventions among the three groups (dance, exercise, and control) using a two-way analysis of variance. The results showed interactions for TUG step number, BBS, FAB, MRT response time, and UPDRS but not for the other outcome measures.

Was this study adequately powered (large enough to show a difference)?

YES ☒ NO ☐	*Explanation:* The study had 46 participants, with an estimated sample size of 14 participants per group, for a significance level $\alpha = .05$ and a statistical power of 0.8, on the basis of Cohen's effect size.

Were the analysis methods appropriate?

YES ☒	*Explanation:* The authors used a chi-square test to analyze group differences

NO ☐	on noncontiguous variables. They used analysis of variance tests to compare the means of each measure among the three groups. They used a paired *t* test to compare the means between pre- and posttests.

Were statistics appropriately reported (in written or table format)?

YES ☒ NO ☐	*Explanation:* All results were reported in the Results section of the article. Tables were used to display the baseline participant demographics as well as intragroup and intergroup comparisons of motor function, cognitive function, mental symptoms, general symptoms. Tables also showed intergroup comparisons on motor functions, cognitive functions, and mental symptoms.

Was participant dropout less than 20% in total sample and balanced between groups?

YES ☐ NO ☒	*Explanation:* The study started with 59 original participants, and a total of 13 participants were lost, for an attrition rate of 22%. The sample size of the groups remained balanced, however, because a similar number of participants dropped out from each group. Regardless, because the attrition rate was greater than 20%, bias might have occurred from individuals feeling that the interventions were ineffective.

What are the overall study limitations?

A limitation is the unequal ratio of men to women in each group. Japanese men typically do not participate in group activities, which may explain the small sample size of men. Additionally, the researchers analyzed the total scores of outcome measures, rather than subscale scores of the FAB and UPDRS. As a result, the researchers might have overlooked other possible significant correlations. Also, although previous studies found that dance triggered the basal ganglia network, an area of impairment for patients with PD, this study did not directly measure basal ganglia activity.

Other limitations not stated in the study are a potential practice effect for the FAB and MRT and recall bias for the SDS, AS, and UPDRS because of slight improvements even in the control group. Given that different instructors and locations were used for the study, intervention biases might have occurred, which risks the reliability of the findings. Last, generalizability may be contestable, because recruitment only occurred in Japan. Further research is needed to eliminate culture as an influential variable in the effectiveness of dance.

CONCLUSIONS

Overall, dance may significantly improve motor symptoms, cognitive symptoms, mental symptoms, and overall PD symptoms. The improvements in gait and balance for the dance group may be attributed to the fact that the dance intervention involved combinations of forward–backward and side-to-side steps that the exercise intervention did not include. The improvements in cognitive functioning may be due to the fact that dance involves attending to music, imagining future movements, and learning complex movements. This type of motor imagery activates the frontal lobe and basal ganglia loops to influence short-term memory and

execution of actions. A comparable improvement in cognition was not observed in the PD exercise group, which depended on repetitive movements and thus demanded less cognitive control over participants' movements.

Moreover, the dance group saw significant improvements in mental symptoms and an increase in positive feelings through the use of music. In addition, the participants in the dance group had many more interactions with one another, which likely created feelings of unity that decreased anxiety and improved mood and motivation. In contrast, the participants in the PD exercise group experienced no effects on mental symptoms, possibly because they had fewer interactions with other participants. Finally, the control group, which did not receive any intervention, had a significant increase in symptoms of PD on the basis of scores from the UPDRS. Overall, the results suggest that dance may be a therapeutic intervention for improving general symptoms, particularly mental symptoms, among individuals with Parkinson's disease.

This work is based on the evidence-based literature review completed by May Anne Gamueda, OTS, Caroline Lee, OTS, Susan Nguyen, OTS, Ajay Pala, OTS, Blanka Pentek, OTS, and Kitsum Li, OTD, OTR/L, CSRS, faculty advisor, Dominion University.