

# Effects of Balance Training Using a Wii Fit Balance Board on Balance, Gait and Activities of Daily Living in Patients with Parkinson Disease: A Pilot, Randomized Controlled Trial

Jong-Hoon Moon<sup>1</sup>, Jin-Hwa Jung<sup>2</sup>, Hwi-Young Cho<sup>3</sup>

<sup>1</sup>Professor, Department of Occupational Therapy, Kyungdong University, <sup>2</sup>Professor, Department of Occupational Therapy, <sup>3</sup>Professor, Department of Physical Therapy, Gachon University, Republic of Korea

## Abstract

**Background/Objectives:** This study examined the effects of balance training using a Wii Fit balance board on the balance, gait, and activities of daily living in patients with Parkinson disease.

**Method/Statistical Analysis:** Our study included 15 patients with Parkinson disease who scored 2–3 on the Hoehn and Yahr scale and underwent occupational therapy. Participants were randomly assigned to two groups: the experimental group with 8 patients or the control group with 7 patients. All subjects in two groups received traditional occupational therapy (TOT) for 30 min/day, 3 times a week, for 8 weeks, and the participants in the experimental group additionally received a balance training using a Wii Fit (BTWF) for 30 min per session. All patients in both groups were evaluated using the Berg balance scale (BBS), the time up & go test, and the modified Barthel index.

**Findings:** The experimental and control groups showed significant improvements in all outcome measures after intervention. In particular, the experimental group showed a more significant improvement in the BBS score than the control group.

**Improvements/Applications:** BTWF could be effectively used to improve the balance of Parkinson's disease patients in the clinic.

**Keywords:** *Activities of daily living, Balance, Gait, Parkinson disease, Wii Fit.*

## Introduction

Parkinson disease is a progressive retrograde motor disability caused by degeneration of the substantia nigra and lack of dopamine generation<sup>[1]</sup>. Common symptoms of Parkinson's disease are hypokinesia, tremor, bradykinesia, postural instability, rigidity, and disequilibrium<sup>[2]</sup>.

Gait and balance disturbance are common in patients with this condition<sup>[3]</sup>, and they have concerns about falling because their movements and functional ability are impaired<sup>[4]</sup>. They also lack self-confidence regarding functional movements and postural balance, compared to healthy people<sup>[5]</sup>, because of which they cannot perform activities of daily living (ADL) independently and their quality of living is decreased<sup>[6-7]</sup>.

Over the last few decades, several studies have reported a variety of rehabilitation therapies that mediate the symptoms associated with Parkinson's disease<sup>[8]</sup>. Rehabilitation exercise, in particular, increased the balance and lower extremity strength and prevented depression of Parkinson's patients<sup>[9-11]</sup>.

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### Corresponding Author:

**Hwi-Young Cho**

Professor, Department of Physical Therapy, Gachon University, Republic of Korea

e-mail: hwiyoung@gachon.ac.kr

Among them, virtual reality (VR) therapy using Wii Nintendo is becoming popular nowadays because it efficiently improves function of people with Parkinson disease. This intervention is affordable, accessible, and is fun and interesting to patients, so their motivation and concentration toward exercising are better<sup>[12]</sup>.

Previous studies showed that therapeutic exercise training using a Wii Fit balance board has a positive effect on balance, cognitive function, gait, and actual ADL in patients with Parkinson disease<sup>[13-15]</sup>. Mhatre et al.<sup>[13]</sup> reported that Nintendo Wii™-based exercise and cognitive-training (VR games) effectively improves gait ability and balance function in the individual with parkinson disease. Further, Hertz et al.<sup>[14]</sup> reported that the Wii Nintendo Virtual Reality system is effective in improving motor function, depression, and ADL in patients with parkinson disease.

However, Santos et al.<sup>[16]</sup> reported that Nintendo Wii intervention had no additional positive-effects on conventional exercises in functional mobility, and balance of patients with parkinson disease. According to a recent systematic review, most previous studies were performed without the control groups and the research conducted by randomized controlled trials (RCT) study design is insufficient<sup>[12]</sup>.

Therefore, the present study aimed to assess the effects of balance training using a Wii Fit balance board on balance, gait, and ADL in individuals with Parkinson disease.

## Method

We recruited 15 subjects with Parkinson disease who were undergoing occupational therapy at in-and out-patients rehabilitation hospital. The inclusion criteria were (1) age exceeding 30 years and a diagnosis of idiopathic parkinson disease, (2) moderate motor impairment (a Hoehn and Yahr scale score of 2–3), (3) having been on the same medication for management of neurologic or other reasons for longer than 2 weeks, (4) ability to walk longer than 50 m independently with or without orthosis, and (5) a score exceeding 24 on the Mini–Mental State Examination. The exclusion criteria were (1) other orthopedic or neurological problems, (2) cardiac problems, (3) migraine or dizziness, (4) participation in any regular exercise program or other rehabilitation programs, and (5) auditory and/or visual deficits. All subjects participated in this study were informed about the procedure and consented to the

study. Our study was approved by the Institutional Review Board of Gachon University (1044396-201708-HR-136-01). Also, present study is in accordance with the Declaration of Helsinki.

The Berg balance scale (BBS), time up & go test (TUG), and modified Barthel index (MBI) were used to evaluate balance, gait, and ADL in both groups. All outcome tests were performed under blinded condition by a physical therapist with minimum 5 years of experience. In order to perform more accurate measurements, the measurer was trained and checked on the measurement method used in this study one week before the test.

The BBS was used to assess subjects' balance. It has 13 categories and a total score of fifty six. Higher score indicates a better balance. It is known that the risk of falls is higher and orthosis is required when the score is lower than 45<sup>[17]</sup>. The intra-rater reliability of this test is  $r = .97$  and its inter-rater reliability is  $r = .98$ <sup>[18]</sup>.

The TUG was developed to improve objectivity and reliability, and it was performed by determining the time required to stand up from a chair, walk comfortably for three meter, and then return to the chair. The rater used a stopwatch and checked the time between when the subject stood up from the chair until they sat back down on the chair. The intra-rater reliability of this test was found to be  $r = .99$  and its inter-rater reliability was  $r = .98$ <sup>[19]</sup>.

The MBI was used to evaluate ADL. This tool has 10 categories and the scores range from zero to one hundred. A score of 0 indicates complete dependence, while 100 indicates complete independence while performing modified ADL. The intra-rater reliability of the MBI is  $r = .89$  and the inter-rater reliability is  $r = .95$ <sup>[20]</sup>.

Fifteen participants were randomly assigned and divided into the experimental group ( $n = 8$ ) and the control group ( $n = 7$ ) after a pre-test evaluation. Every subject underwent traditional occupational therapy (TOT) for 30 min/day, 3 times a week, for 8 weeks, but the experimental group had an additional 30 min of balance training using Wii Fit (BTWF) per session.

The BTWF consists of three games: a bubble game, a ski game, and a marble game. In the initial session, all subjects were trained to learn how to use the Wii Fit balance board. The occupational therapist informed the therapeutic goals of these games and provided feedback

at all sessions. Subjects are assigned 10 min for each game with 5-10 min of rest in between games. Subjects wore a safety belt during the training. If necessary, subjects used static walkers for balance and safety. The control group received TOT. TOT consisted of ADL training targeting basic activity, repetitive training, stretching, range of motion (ROM) of the upper and lower limbs.

SPSS version 23.0 was used for all statistical analyses. The Wilcoxon-signed rank test was performed to compare dependent variables within the groups before and after intervention. The Mann-Whitney U test was used to compare differences in the dependent variables between the groups. A p-value of <0.05 was considered statistically significant.

## Result and Discussion

- 1. General characteristics:** No significant differences were found between the groups ( $p > 0.05$ ) in any parameter [Table 1]. The findings from the BBS, TUG test, and MBI before the interventions did not differ significantly between the groups ( $p > 0.05$ ) [Table 2].
- 2. Difference for BBS, TUG, MBI within groups:** The both groups showed a significant difference in every evaluation after the intervention ( $p < 0.05$ ) [Table 3].
- 3. Change score of BBS, TUG, MBI between two groups:** The change in the BBS findings was higher in the BTWF group than in the TOT group ( $p < 0.05$ ). No significant between-group differences were found in the findings of the TUG test and MBI ( $p > 0.05$ ) [Table 4].

**Table 1. General characteristics**

	Experimental Group (n = 8)	Control Group (n = 7)	p
Age (Year), Mean±SD	63.38±5.37	62.14±5.55	.601
<b>Gender, n (%)</b>			
Male	5 (62.5)	5 (71.4)	.714
Female	3 (37.5)	2 (28.6)	
Hoehn & Yahr Scale, Mean±SD	2.63±0.52	2.71±0.49	.724
Onset Duration (Months), Mean±SD	11.50±4.28	11.57±4.58	.907
K-MMSE, Mean±SD	27.88±1.55	28.00±1.91	.860

BTWF: Balance training using Wii Fit; TOT: Traditional occupational therapy, K-MMSE: Korean Mini-Mental State Examination, SD: standard deviation.

**Table 2. Comparisons of BBS, TUG, MBI before intervention**

	Experimental Group (n = 8)	Control Group (n = 7)	p
BBS (score)	43.88±3.80	45.00±3.79	.484
TUG (sec)	21.09±3.58	20.86±3.05	.817
MBI (score)	78.63±7.19	79.71±6.26	.519

BTWF: Balance training using Wii Fit; TOT: Traditional occupational therapy, BBS: Berg Balance Scale, TUG: Time Up & Go test, MBI: Modified Barthel Index, SD: standard deviation.

**Table 3. Difference for BBS, TUG, MBI within groups**

	Experimental Group (n = 8)		p	Control group (n = 7)		p
	Pre	Post		Pre	Post	
	Mean±SD	Mean±SD		Mean±SD	Mean±SD	
BBS (Score)	43.88±3.80	46.38±3.81	.011*	45.00±3.79	46.29±4.39	.024*
TUG (Sec)	21.09±3.58	19.82±3.56	.012*	20.86±3.05	20.08±3.00	.018*
MBI (Score)	78.63±7.19	89.00±5.35	.012*	79.71±6.26	89.43±3.21	.018*

\* $p < 0.05$ , BTWF: Balance training using Wii Fit; TOT: Traditional occupational therapy, BBS: Berg Balance Scale, TUG: Time Up & Go test, MBI: Modified Barthel Index, SD: standard deviation.

**Table 4. Change score of BBS, TUG, MBI between two groups**

	Experimental Group (n = 8)	Control Group (n = 7)	P
	Mean±SD	Mean±SD	
BBS (Score)	2.50±0.93	1.29±0.95	.031*
TUG (Sec)	-1.27±0.67	-0.77±0.70	.165
MBI (Score)	10.38±3.85	9.71±4.23	.725

\*p<0.05, BTWF: Balance training using Wii Fit;TOT: Traditional occupational therapy, BBS: Berg Balance Scale, TUG: Time Up & Go test, MBI: Modified Barthel Index, SD: standard deviation.

## Discussion

Our findings showed significant improvements after the interventions in both the BTWF and TOT groups. The former showed better improvements in BBS findings than the TOT group did, although the difference in the findings of other tests were not considerable. Thus, BTWF can improve the balance of patients with Parkinson disease. The experimental group got higher scores on the TUG test and MBI than the control group did, but the difference was not significant. This can be explained by a few reasons.

First, the sample size in this study was small. Second, BBS and ADL are strongly related<sup>[21]</sup>, and the categories of MBI are related not only to the functions of lower extremities but also to those of upper extremities, such as feeding, personal hygiene, and dressing<sup>[20]</sup>. A difference in the MBI score indicates a difference in upper extremity function. However, we did not evaluate upper extremity function in this study. Lastly, we did not control for Parkinson disease drugs, although none of the subjects reported using Parkinson disease drugs.

It has been reported that in hospitals, occupational therapy is not usually administered for improving lower extremity function or balance but for improving upper extremity function. Our findings indicate that using Wii Fit is a good way to effectively improve upper extremity function as well as balance and lower extremity function. There are some benefits to using virtual reality devices like Wii Fit. They cost less than other VR programs and are easy to use at home<sup>[12]</sup>. There is a high chance of people with Parkinson disease have depression, and this increases fatigue and helplessness<sup>[6,11]</sup>. Depression is not just a psychological problem; it limits motivation for rehabilitation. Their confidence, social participation, and quality of life are decreased because of this problem. Although the subjects' motivation or depression was not evaluated, Wii Fit is expected to positively affect

depression or rehabilitation training by promoting patients' interest.

Present study has limitations. First, because of the limited subjects, the changes in test findings before and after the intervention were not clear. Further, patients with scores of 2 or 3 on the Hoehn and Yahr scale may not represent all patients with Parkinson disease. Lastly, we did not follow up the subjects after the study, so we could not evaluate how long the effects exist. Further studies are required to overcome these limitations.

## Conclusion

This study examined the effects of balance training using a Wii Fit balance board on the balance, gait, and ADL in people with Parkinson disease. In conclusion, BTWF for 8 weeks is more effective than TOT in improving the balance of people with Parkinson disease. Next studies are needed to examine motivation, satisfaction, or quality of life as well as physical function among people with parkinson disease who are administered BTWF, and more patients should be included for long-term effects.

**Ethical Clearance:** Not required

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**Conflict of Interest:** Nil

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