JMSCR Vol||3||Issue||12||Page 8717-8724||December 2015

www.jmscr.igmpublication.org

Impact Factor 3.79
Index Copernicus Value: 5.88
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: http://dx.doi.org/10.18535/jmscr/v3i12.43

Journal Of Medical Science And Clinical Research
IGM Publication
An Official Publication Of IGM Publication

Influence of Interactive Therapy on Improving Balance Outcomes in Patients with Multiple Sclerosis

Authors
Wanees M Badawy, Hoda M Zakaria, Bassam A El-Nassag
Dept. of Neuromuscular Disorders and Its Surgery, Faculty of Physical Therapy, Cairo University, Egypt

Abstract
Background: *Multiple sclerosis (MS) is a chronic progressive auto-immune disease that results in demyelination of the central nervous system. The symptoms and complications in addition to impairments and disability in MS patient often reduce the balance outcomes.*
Purpose: *To determine the influence of using the Wii interactive video game as a treatment program to improve the balance outcomes in MS patient.*
Materials and methods: *Thirty MS patients were randomly allocated to two equal groups. The control group received a traditional balance program for 45 minutes and the study group received a virtual reality rehabilitation based on the Nintendo® Wii Balance Board® (WBB) for 30 minutes in addition to the balance exercises given to the control group. The training was three times per week for 4 successive weeks.*
The outcome measures: *Berg Balance Scale (BBS), Timed Up and Go test (TUG), the overall dynamic limits of stability measured by the Biodex Balance System, and the Activities-Specific Balance Confidence Scale (ABC).*
Results: *There was an improvement in all measures in both groups. But the improvement in the balance outcomes was more in the study group.*
Conclusion*: Wii rehabilitation appears to be a useful tool in improving balance outcomes in MS. Further studies have to be carried out to assess the retention of results and generalization.*
Keywords: *Multiple sclerosis, Balance, Wii interactive video game*

Introduction

Multiple sclerosis (MS) is a chronic inflammatory disease in which the myelin sheaths of nerve cells in the central nervous system are damaged [1-2]. Commonly, it affects many young and middle-aged individuals, especially females more than males (2–3:1) [2]. Generally, MS patient presents with many symptoms. One of the most symptoms is fatigue affecting between 50% and 80% of patients [1,2]. Besides that, impaired balance affects about 75% of patients over the course of the disease. Balance impairments identified by increased sway in static balance, delayed reactions to postural perturbations, and a reduced capability to move toward their limits of stability [3]. Furthermore, it is widely recognized that many

MS patients have changes of sensation (e.g., numbness and paresthesia), motor abnormalities such as muscle weakness, bladder/bowel incontinence and cognitive impairment [2]. However, these symptoms with high inactivity of MS patient altogether increase the risk of developing secondary complications (e.g., obesity and heart disease). These complications in addition to other impairments and disability often prevent patients from performing their activities of daily living (ADL) [1].

For this reason, wide traditional training programs in physical therapy can be used such as balance training and strengthening exercises but with time, these exercises can become repetitive and worthless, and thus decrease the motivation and adherence to treatment [4]. On the other hand, exercise using interactive video games in the rehabilitation scientifically growing in the last few years and become quite providing meaningful, intensive, enjoyable, motivational and purposeful tasks related to ADL [3]. In fact, the Nintendo Wii is one of the inexpensive interactive video games introduced in November 2006. It is virtual reality training provide auditory and visual feedback. The device is based on motion capture technology using full body movements to control on-screen action and receive instructions and feedback on performing the exercise [5]. In addition, sometimes require standing on a platform (the balance board) to give a continuous visual feedback about movement pattern accuracy by pressure sensors and wireless signals [3]. Previous studies have shown the benefits of Wii for spastic diplegic cerebral palsy; it improves their visual-perceptional processing, postural control and functional mobility [6]. Another study among elderly with Parkinson's disease (PD) using the Wii for 4 weeks demonstrated that Wii effectively improves the functional independence and quality of life for individuals with PD in the short-term [7]. In another study, Nintendo Wii has an effect in improving standing balance with acquired brain injury patients and in enhancing a general condition of well-being[4]. However, there is alimited researches support the benefits among MS patients. This study was conducted to determine the influence of interactive therapy in improving postural control in MS patient.

Materials and methods

There were 36 patients with MS who were potential candidates for this study. Patients referred from Neurology Out-patient Clinicat Kasr El Aini Hospital, Cairo University. The inclusion criteria were: (1) young adults with MS diagnosed by a neurologist, (2) men and women between 20 and 35 years old, (3) having relapsing-remitting, primary progressive, or secondary-progressive MS, (4) having mild-to-moderate MS-related disability (Expanded disability status scale (EDSS) score ≤-6.0)[8], (5) able to follow instructions, (6) able to walk 10 meters indoors with or without technical orthopedics aids, (7) absence of cognitive impairment (Mini-Mental State Examination (MMSE) cut-off >23) [9], and (8) no previous experience with virtual rehabilitation systems.

The exclusion criteria were: (1) having flare-up symptoms, (2) patients whose visual or hearing impairment does not allow possibility of interaction with the system, (3) patients with ataxia or any other cerebellar symptom, having a self-reported musculoskeletal, neurological, or medical condition other than MS that is known to affect balance or gait and is associated with falls, such as a lower-limb joint replacement, peripheral neuropathy, vestibular disorder, stroke, and seizures, (4) being >3 months pregnant, or (5) cannot physically complete all rehabilitation sessions.

With these criteria, a final sample of 30 patients was selected and randomly assigned to either the control group (motor strategy training) or the study group (Wii balance board therapy). All patients were on a similar baseline, with a level and type of impairment constant within groups. The randomization schedule was computer-generated using a basic random number generator. All subjects provided informed consent approved by the ethical committee of the Faculty of Physical therapy, Cairo University, prior to their participation.

Intervention

Before starting a program, the examiner physical therapist conducted initial assessment before introducing the physical program by other therapists. Thenfinal assessment procedures were conducted using the same measurements that included:

1. Berg Balance Scale (BBS): It consists of a 14-items used to evaluate balance and explore the ability of patient's performance in various tasks such as sitting, standing. Rate the performance from 0 (cannot perform) to 4 (normal performance), a maximum total score is 56. The validity and reliability of the scale have been assessed on population of subjects with multiple sclerosis [10,11].
2. Timed Up and Go test (TUG): The time that the patient took to stand up from an armchair, walked as quickly as he or she could for 3 meters, turned, walked back to the chair, and sat down, was recorded. It is valid and reliable for MS patient [12].
3. Biodex Balance System (Biodex Crop. Shirley, Ny, USA): This system uses a circular platform that is free to move in the anterior-posterior and medial-lateral axes simultaneously. It allows up to 20° of foot platform tilt so the patient is challenged to maintain his/her center of gravity (COG)over their base of support by trying to keep the platform level. The Biodex Stability System offers several levels of difficulty from L1 (most difficult) to L8 (least difficult), which determines the rate of deflection of the platform. The dynamic stability test was used in this study to challenge the patient by promoting the movement of the cursor to eight blinking target within the dimension of limits of stability (LOS) within a specific time (maximum 5 minutes). The overall dynamic limit of stability (ODLOS) score calculated by the stability system was chosen for this study as the average of the eight individual dynamic limit of stability scores generated by the device for each test (Score = (Shortest distance between the central and the target box/Total distance covered between the central and target box)x100)[13].

In the present study, patients were tested bilaterally at L8. The test was conducted once, preceded by a 30 second practice trial. Patients were dressed comfortably with bared feet. Prior to the test, they were asked to adopt a standardized foot position on the platform. After the auditory countdown, the subject was instructed to start moving the cursor toward the flashing target. The cursor had to stay within the target box for a minimum of 0.5 seconds before it disappeared and showed the next target on the screen. The test ended when the eight target boxes had been reached and the cursor repositioned in the central box. Touching the rail was permitted to avoid falling but grasping was not allowed. No specific upper limb position was imposed during the test.

4. Activities-Specific Balance Confidence Scale (ABC): A questionnaire developed to measure an aspect of the psychological impact of balance impairment and/or falls. The patient was asked to rate his or her confidence in performing each of the activities on a scale from 0 (no confidence) to 100% (complete confidence) without losing balance or becoming unsteady. The average score obtained is an indication on balance confidence[13-15].

The control group (G1) received balance exercises just for motor strategies. The study group (G2) received Wii balance board therapy program that aimed at improving motor and sensory strategies. Patients from both groups participated in a 45 minutes session (excluding rest time) three times per week for a period of four weeks. Control and study group patients participated in exercise sessions composed of the following exercises [16] : 1- stepping forward, backward, and sideways on the exercise step; 2- stepping over blocks of various heights; 3- standing up from a chair, walking four steps forward, performing a bilateral stool touch and walking backwards to the chair; 4- standing up from a chair, walking four steps forward, turning to the right, stepping over the exercise step, turning to the right again and walking forwards to the chair (repeat the exercise circuit in the opposite direction); 5- from a sitting position on a 65-cm Swiss ball, performing a range of motion and balance exercises (forward and backward rolling of the arms; bending the trunk forward and side to side).

While patients in the study group (G2) after completed the traditional balance exercises were engaged in each session to participate in a virtual reality system based on the Nintendo® Wii Balance Board® (WBB) for 30 minutes. The hardware components of this system consist of a conventional PC, a 42” LCD screen and a WBB. The communication between this device and the computer is established via Bluetooth protocol. This way, the exercises run on a PC and the system uses the WBB as interface. Three games were selected by the physical therapist and repeated throughout the training period. They consisted of Table Tilt, Basic step, and Ski Slalom. “Table Tilt” required very refined weight shifts in all directions in order to move balls across a board and into holes. “Basic step,” patient step to the front, back, left,and right to help to improve his or her sense of rhythm. “Ski Slalom,” the patient shifted his or her weight right and left to ski through the various flags on the screen. Then, shifted the weight to the front and to the back to effect the speed of the virtual skier [5, 17]. During all sessions, the physical therapist encouraged the patient to progress to more difficult games and registered the time needed to rest during the session.

Statistical analysis

All statistical tests were performed using SPSS for windows Version 19 (Chicago, IL, USA). All values were expressed as a mean ± standard deviation (SD) or median (range) value, as appropriate. Non parametric tests (Wilcoxon Signed-ranks, Mann Whitney and Chi-squared tests) were also used. The significant level of $p < 0.05$ was considered significant.

Results

No significant differences in demographical (age and gender) or clinical (duration of illness and EDSS) variables at inclusion were detected between groups (Table. 1). No statistically significant differences were found in base line measurements between both groups (Table 2). There was significant difference for all variables before and after treatment for both groups, however the study group (G2) showed more improvement in proportion to the control group (G1) as shown in table 3 and 4. In addition, all the patients in G2 remarked that they had fun during the treatment.

Table (1): General characteristics of the patients

Variables	G1 (n=20)	G2 (n=20)	Significance
Age (yrs) $\bar{x}$ (SD)	29.2(5.5)	28.5(5.3)	0.739[a]
Gender (M:F)	10:5	9:6	0.704[b]
Duration of illness (yrs) $\bar{x}$ (SD)	3.6(1.9)	4.1(1.2)	0.373[a]
EDSS median (range)	3 (1-5)	3.1 (1.5-5.5)	0.849[c]

$\bar{x}$, mean; SD,EDSS, Expanded Disability Status Scale; standard deviation; [a], significance determined by an independent t-test; [b], significance determined by Chi-squared Test; [c], significance determined by Mann-Whitney test.

Table (2): Baseline values of the scores of scales and tests in the assessments carried out before the treatment in both groups

Test	G1 x̄ (SD)	G2 x̄ (SD)	MD	P-value
BBS, median (range)	36(34-42)	37(32-43)	-1	0.280
TUG (s)	25.4(2.5)	25.5(2.4)	-0.12	0.968
ODLOS (%)	42(2.1)	43.7(2.6)	-1.67	0.109
ABC (%)	53.4(4.4)	55.9(3.7)	-2.53	0.061

BBS, Berg Balance Scale; TUG, Timed Up and Go Test; ODLOS, Overall Dynamic Limits of Stability, ABC, Activities-Specific Balance Confidence Scale, P-value, probability level.

Table (3): Comparison between the values of the scores of scales and tests in the assessments carried out before and after the treatment within each group.

Test	G1		MD	S	G2		MD	P-value
	Before treatment x̄ (SD)	After treatment x̄ (SD)			Before treatment x̄ (SD)	After treatment x̄ (SD)		
BBS median (range)	36 (34-42)	41 (37-45)	-4	0.001	37 (32-43)	43 (40-48)	-7	0.0006*
TUG (s)	25.4(2.5)	21.1(2.8)	4.34	0.000	25.5(2.4)	18.8(2)	6.72	0.000*
ODLOS (%)	42.1(2)	51.9(4.1)	-9.8	0.0006	43.7(2.6)	60.8(4.1)	-17.13	0.0006*
ABC (%)	53.4(4.4)	63.2(5.9)	-9.86	0.0006	55.9(3.7)	69.1(3.6)	-13.2	0.0006*

BBS, Berg Balance Scale; TUG, Timed Up and Go Test; ODLOS, Overall Dynamic Limits of Stability; ABC, Activities-Specific Balance Confidence Scale;x̄, Mean; MD, Mean difference;P-value, probability level; *, significant.

Table (4): Comparison between the values of the scores of scales and tests in the assessments carried out after the treatment in both groups.

Test	G1 x̄ (SD)	G2 x̄ (SD)	MD	P-value
BBS median (range)	41(37-45)	43(40-48)	-2	0.006*
TUG (s)	21.06±2.81	18.8±2.0	2.26	0.019*
ODLOS (%)	51.86±4.19	60.86±4.10	-9	0.000*
ABC (%)	63.26±5.93	69.13±3.62	-5.87	0.008*

BBS, Berg Balance Scale; TUG, Timed Up and Go Test; ODLOS, Overall Dynamic Limits of Stability; ABC, Activities-Specific Balance Confidence Scale;x̄, Mean; MD, Mean difference;P-value, probability level; *, significant.

Discussion

Nintendo Wii was selected for this study because it is one of the popular video games consoles. There were a lot of researches that support the efficacy of Nintendo Wii among different conditions such as, cerebral palsy, stroke, acquired brain injury and Parkinson disease. As yet, no published study investigated the influence of Nintendo Wii in improving balance outcomes among MS patients. In the treatment program of this study the patient trained for 4 weeks, 3 times per week at the most relaxed, comfortable and preferred time for such patients during the day, since the appropriate time is an important factor to gain successful treatment in MS patient. Also, to provide the accuracy and validity for the outcomes. In each session total of 45-min trained using Wii, taking a rest for 5-min after every 10-min of exercising to prevent the occurrence of fatigue. Additionally, all sessions were done under supervision of physical therapists, may have increased confidence and motivation to exercise due to the presence of a therapist and monitoring during training. This could especially affect factors, such as fatigue, which is linked to mood [2]. The main finding of this study is that of the Nintendo Wii training reduce the impact of MS on patient quality of life through improving balance, weight distribution, functional activity, reducing fatigue and depression level.

A clarification for the noticeable improvement of balance in MS patient who trained by Nintendo Wii is that to maintain symmetrical weight shift on both legs. This is agreed with McGough et al. (2011) who previously reported that the asymmetries of the weight shift were assessed and generally improved by using Nintendo Wii [18]. Another study supported that reasoning of improved balance; it was among cerebral palsy patients according to Deutsch, et al., (2008) "the weight distribution of lower extremities became more symmetrical, and hehad a decrease in postural sway, indicating an increase in stance stability" [6]. In addition; another study used the Nintendo Wii Fit for balance training in an elderly healthy subjects; the result of the study was a high significant improvement on the balance after 4 weeks of intervention especially in BBS measures [19]. This is may be due to the nature of the MS disease which is considered as progressive type. In addition to that, the patient COG was closed to the center at the end of treatment sessions. Furthermore, the fatigue level decreased and this is may be due to decreased the level of depression. Induruwa et al. (2012) stated that fatigue and depression were highly correlated, and that depressed mood and disability were significant predictors of fatigue in MS patients, they also found that depressed subjects had such symptoms as lack of motivation, inability to complete tasks and sleep disturbance, can overlap with fatigue[2]. There was a positive effect of the device in reducing the depression level by motivating the patient to increase his or her practice volume and attention span during training. The increased scores of ABC scale seen in the study group could be seen in engaging the patients with exercise, build up their confidence in their abilities, improve self-identify and positivity[20]. These finding also agreed with studies suggesting that an increase in postural control strategies lead to clinical improvement not only in balance skills but also in walking performance[4]. So, numerous advantages and benefits of using the Wii for rehabilitation purposesas it provides an inexpensive interactive environment for the patient. Also, it is ease of use as well as the entire system is small and low weights (approximately five kilograms). In addition to that, the level of difficulty can be increased by using various heights and densities applied on the top of WBB. One limitation of this study is the small sample size, as the results have restricted generalizability. A larger study with a numerous group of patients, more treatment sessions and a follow-up assessment are needed to increase confidence in the results.

Conclusion

The Wii rehabilitation appears to be a useful tool in improving balance outcomes for MS patients. Further studies have to be carried out to assess the ability to retain and generalize the effect of videogame intervention.

References

1. Plow M, Finlayson M, Motl RW, Bethoux F. Randomized controlled trial of a teleconference fatigue management plus physical activity intervention in adults with multiple sclerosis: rationale and research protocol. BMC Neurol. 2012: Oct 16: 12:122.
2. Induruwa I, Constantinescu CS, Gran B. Fatigue in multiple sclerosis - a brief review. J Neurol Sci. 2012: Dec 15: 323(1-2):9-15.
3. Cameron MH, Lord S. Postural control in multiple sclerosis: implications for fall prevention. Curr Neurol Neuro Sci Rep. 2010: Sep 10(5):407-12.
4. Cattaneo D, Jonsdottir J, Zocchi M, Regola A. Effects of balance exercises on people with multiple sclerosis: a pilot study. ClinRehabil. 2007: Sep 21(9):771-81.
5. Gardner B. Effectiveness of The Nintendo® Wii Fit™ Games on The Balance of a Community-Dwelling Older Adult in Eastern North Carolina. Unpublished master's thesis, East Carolina University, Department of Occupational Therapy. 2011 Jun.
6. Deutsch JE, Borbely M, Filler J, et al. Use of a low-cost, commercially available gaming console (Wii) for rehabilitation of an adolescent with cerebral palsy. PhysTher 2008: 88: 1196–07.
7. Herz NB, Mehta SH, Sethi KD, Jackson P, Hall P, Morgan JC. Nintendo Wii rehabilitation ("Wii-hab") provides benefits in Parkinson's disease. Parkinsonism Relat Disord. 2013 Nov: 19(11): 1039-42.
8. Kurtzke JF. Rating neurologic impairment in multiple sclerosis: An expanded disability status scale (EDSS). Neurology.1983: 33(11):1444–52.
9. Pangman VC, Sloan J, Guse L. An Examination of Psychometric Properties of the Mini-Mental State Examination and the Standardized Mini-Mental State Examination: Implications for Clinical Practice. Applied Nursing Research. 2000: 13 (4): 209–213.
10. Cattaneo D, Regola A, Meotti M. Validity of six balance disorders scales in persons with multiple sclerosis. Disabil Rehabil. 2006: Jun 30: 28(12):789-95.
11. Cattaneo D, Jonsdottir J, Repetti S. Reliability of four scales on balance disorders in persons with multiple sclerosis. Disabil Rehabil. 2007: Dec 30;29(24):1920-5.
12. Nilsagård Y, Carling A, Forsberg A. Activities-specific balance confidence in people with multiple sclerosis. Mult Scler Int. 2012:613925. doi: 10.1155/2012/613925. Epub 2012 Aug 7.
13. Perron M, Hébert LJ, McFadyen BJ, Belzile S, Regniére M. The ability of the Biodex Stability System to distinguish level of function in subjects with a second-degree ankle sprain. Clin Rehabil. 2007: Jan 21(1): 73-81.
14. Miller WC, Deathe AB, Speechley M. Psychometric properties of the Activities-specific Balance Confidence Scale among individuals with a lower-limb amputation. Arch Phys Med Rehabil. 2003: May 84(5): 656-61.
15. Whitehead C, Miller M, Crotty M. Falls in community-dwelling older persons following hip fracture: impact on self-efficacy, balance and handicap. Clin Rehabil. 2003: Dec 17(8): 899-906.

16. Bayouk JF, Boucher JP, Leroux A. Balance training following stroke: effects of task-oriented exercises with and without altered sensory input. Int J Rehabil Res. 2006: 29: 51-9.
17. Gil-Gómez JA1, Lloréns R, Alcañiz M, Colomer C. Effectiveness of a Wii balance board-based system (eBaViR) for balance rehabilitation: a pilot randomized clinical trial in patients with acquired brain injury. J Neuroeng Rehabil. 2011: May 23: 8:30. doi: 10.1186/1743-0003-8-30.
18. McGough R, Paterson K, Bradshaw E, Bryant A, Ross C. The Use Of Nintendo Wii Balance Board For Real-Time Investigation Of Weight Bearing Asymmetry. Portuguese Journal of Sport Sciences. 2011:11 (Suppl.2).
19. Bieryla KA, Dold NM. Feasibility of Wii fit training to improve clinical measures of balance in older adults. Clin Inter Aging. 2013: 8: 775-81.
20. Stuifbergen AK, Blozis SA, Harrison TC, Becker HA. Exercise, functional limitations, and quality of life: a longitudinal study of persons with multiple sclerosis. Arch Phys Med Rehabil. 2006: Jul 87(7):935-43.