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SYSTEMATIC REVIEW

Effectiveness of Nintendo Wii in functional and health outcomes of individuals with Parkinson's disease: a systematic review

Eficácia do Nintendo Wii em desfechos funcionais e de saúde de indivíduos com doença de Parkinson: uma revisão sistemática

Eficacia del Nintendo Wii en resultados funcionales y de salud de individuos con enfermedad de Parkinson: una revisión sistemática

Nayara Felicidade Tomaz Braz[1], Letícia Rocha Dutra[2], Paulo Eduardo Souza Medeiros[3], Aline Alvim Scianni[4], Christina Danielli Coelho de Morais Faria[4]

ABSTRACT | The objective of this study was to conduct a systematic review of the literature on the effectiveness of Nintendo Wii in the improvement of functional and health outcomes of individuals with Parkinson's disease. A systematic review of the literature was developed following the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses), with research in MEDLINE, SciELO, LILACS, PEDro through a search strategy that combined the terms Wii, Parkinson's Disease, rehabilitation, and physical therapy, followed by manual search. Inclusion criteria were: experimental studies or quasi-experiments related to interventions involving the use of Nintendo Wii to improve functional outcomes in individuals with Parkinson's disease, published until February 2016, without language restriction. The methodological quality of the studies was assessed with the PEDro scale. Of the 701 studies found, we included seven that met the inclusion criteria – most of the articles (57.14%) had bad methodological quality and were quasi-experiments. The results suggest that the use of Wii seems effective to improve functional outcomes (balance, mobility, motor performance and independence) and health (reducing the risk of falls), being more consistent the results for the improvement of balance. Studies with better methodological quality are needed for the establishment of evidence. Standardization on the types of games, intensity and frequency suitable for each type of patient with PD are still required.

Keywords | Parkinson's Disease; Virtual Reality; Neurology; Rehabilitation; Physical Therapy.

RESUMO | O objetivo deste estudo foi revisar sistematicamente a literatura sobre a eficácia do Nintendo Wii na melhora de desfechos funcionais e de saúde de indivíduos com doença de Parkinson. A revisão foi desenvolvida seguindo o PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*), com buscas nas bases de dados MEDLINE, SciELO, LILACS e PEDro mediante estratégia de busca composta pela combinação dos termos "Wii", "Doença de Parkinson", "reabilitação" e "fisioterapia", seguida de busca manual. Os critérios de inclusão foram: estudos experimentais ou quase-experimentais relacionados a intervenções envolvendo o uso do Nintendo Wii para melhora de desfechos funcionais em indivíduos com doença de Parkinson, publicados até fevereiro de 2016, sem restrição de idioma. A qualidade metodológica dos estudos foi avaliada pela escala PEDro. Dos 701 estudos encontrados,

[1]Physical therapist, PhD student of the Graduate Program in Neuroscience at Universidade Federal de Minas Gerais (UFMG) – Belo Horizonte (MG), Brazil.
[2]Occupational therapist, PhD student of the Graduate Program in Rehabilitation Sciences at Universidade Federal de Minas Gerais (UFMG) – Belo Horizonte (MG), Brazil.
[3]Physical therapist, master's student of the Graduate Program in Sports Science at the Universidade Federal de Minas Gerais (UFMG) – Belo Horizonte (MG), Brazil.
[4]Physical therapist, Assistant Professor of the Department of Physical Therapy, Universidade Federal de Minas Gerais (UFMG) – Belo Horizonte (MG), Brazil.

Corresponding address: Professor Christina Danielli Coelho de Morais Faria – Universidade Federal de Minas Gerais, Escola de Educação Física, Fisioterapia e Terapia Ocupacional, Departamento de Fisioterapia – Av. Antônio Carlos, 6627, Campus Pampulha – Belo Horizonte (MG), Brazil – Zip Code: 31270-901 – Phone: (31) 3409-4783 – E-mail: cdcmf@ufmg.br –
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foram selecionados sete que atenderam aos critérios de inclusão, a maioria (57,14%) apresentava qualidade metodológica ruim e era do tipo quase-experimental. Os resultados sugerem que o uso do Wii parece eficaz para melhora de desfechos funcionais (equilíbrio, mobilidade, desempenho motor e independência) e de saúde (diminuição do risco de quedas), sendo mais consistentes os resultados para melhora do equilíbrio. São necessários estudos com melhor qualidade metodológica para o estabelecimento das evidências e, ainda, padronizações sobre os tipos de jogos, intensidade e frequência adequados para cada tipo de paciente com DP.
Descritores | Doença de Parkinson; Realidade Virtual; Neurologia; Reabilitação; Fisioterapia.

RESUMEN | El objetivo de este estudio ha sido el de revisar sistemáticamente la literatura sobre la eficacia del Nintendo Wii en la mejora de resultados funcionales y de salud de individuos con enfermedad de Parkinson. La revisión sistemática de la literatura ha sido desarrollada siguiendo el PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), con búsquedas en las bases de datos MEDLINE, SciELO, LILACS y PEDro de acuerdo con la estrategia de búsqueda compuesta por la combinación de los términos "Wii", "Enfermedad de Parkinson", "rehabilitación" y "fisioterapia", seguida de búsqueda manual. Los criterios de inclusión han sido: los estudios experimentales o casi-experimentales relacionados a las intervenciones involucrando el uso del Nintendo Wii para la mejora de resultados funcionales en los individuos con enfermedad de Parkinson, publicados hasta febrero de 2016, sin restricción de idioma. La cualidad metodológica de los estudios ha sido evaluada por la escala PEDro. De los 701 estudios encontrados, han sido incluidos siete que atendieron a los criterios de inclusión, la gran parte (el 57,14%) con cualidad metodológica mala y del tipo casi-experimental. Los resultados sugieren que el uso del Wii parece eficaz para la mejora de resultados funcionales (el equilibrio, la movilidad, el desempeño motor y la independencia) y de salud (disminución del riesgo de caídas), siendo más consistentes los resultados para la mejora del equilibrio. Son necesarios estudios con mejor cualidad metodológica para el establecimiento de las evidencias. Todavía son necesarias estandarizaciones sobre los tipos de juegos, intensidad y frecuencia adecuados para cada tipo de paciente con EP.
Palabras clave | Enfermedad de Parkinson; Realidad Virtual; Neurología; Rehabilitación; Fisioterapia.

INTRODUCTION

Parkinson's disease (PD) is a chronic, progressive and degenerative disorder of the central nervous system, the second most common neurodegenerative disease and the leading cause of Parkinsonism, with higher prevalence in the population over 65 years of age and in the male sex[1,2]. In addition to Parkinsonism (presence of bradykinesia and at least one of the following signs: trembling and/or stiffness), the patients with PD may show postural instability, deficits in balance, limitations in activities[3,4], with loss of functional independence and compromise of the quality of life[5,6].

Several studies have investigated the efficacy of rehabilitation associated with the pharmacological treatment in patients with PD for the improvement of health, functionality and quality of life[7]. Recently, virtual reality began to be used in these rehabilitation programs[8]. It is a computerized technology that simulates real environmental stimuli to promote interaction between people and machines based on sensory, cognitive, psychological and motor feedback[8], allowing the intensive repetition of complex tasks and providing a motivational training environment[9].

Among the virtual reality devices with potential for use in rehabilitation, the video game Nintendo Wii stands out with its feasibility, safety and efficacy in the improvement of balance of patients with cerebrovascular accident (CVA), cerebral palsy (CP), multiple sclerosis and traumatic brain injury (TBI). Moreover, in a recent study[10] that aimed to list, compare and classify VR devices that assessed the motor symptoms of people with PD, Nintendo Wii showed good clinimetric properties and was recommended for measuring the postural instability and monitor the motor signs of these individuals. It is noteworthy that Nintendo Wii is a low-cost device when compared with others, and it can be used at home, important characteristic for its applicability in individuals with disturbances caused by brain injuries[10-13]. Despite its advantages and possibilities, it is not yet clear the effectiveness of this technology in the rehabilitation process of individuals with PD. In this context, the objective of this systematic review was to verify the effectiveness of Nintendo Wii in rehabilitating these individuals.

METHODOLOGY

This systematic review was carried out according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)[13], with all the steps conducted by two independent researchers, who, at the end of each step, met to reach a consensus. A third one would be involved in case of disagreement between the two researchers. In the first step, we searched the term "Wii" in the MEDLINE, SciELO, LILACS and PEDro databases. All scientific studies published until February 2016 were included, without language restriction, and with the following inclusion criteria: experimental or quasi-experimental studies, and those that used Nintendo Wii in the rehabilitation process of individuals with PD. In the second step, the titles of all studies found in the electronic databases were evaluated, and those that clearly did not meet the inclusion criteria were excluded. The same procedure was used in the third step with the analysis of the abstracts of studies included in the second step. In the fourth step, we read all the texts included in the previous phase, and those that used Nintendo Wii in the rehabilitation of individuals with PD were included. In the fifth step, another search was conducted in the reference list of all studies included after searching in the electronic databases, following the same procedures.

The scale Physiotherapy Evidence Database (PEDro)[14] was used to determine the methodological quality of each study included. The basis adopted for the interpretation of the quality score was: from 9 to 10, excellent; 6 to 8, good; 4 to 5, reasonable; and less than 4, poor[14].

RESULTS

From the electronic search, 701 studies that used Nintendo Wii were identified, but only seven met the inclusion criteria. New studies that met the inclusion criteria were not found in reference list search (Figure 1). All seven studies were published in the last four years: three in 2012[12,15,16], two in 2013[17,18], one in 2014[19] and one in 2015[20] (Chart 1).

The studies included men and women with PD, with ages that ranged from 44 years to 91 years, with predominance of older adults (average age of 65 years). Five studies used the Hoehn & Yahr scale to assess the PD severity[21]. Three studies included individuals with moderate disability[15,17,19] and two individuals with mild disability[16,20]. Two studies used the Unified Parkinson's Disease Rating Scale (UPDRS)[22] to assess the signs, symptoms and certain activities[12,18]. The average time of involvement of the individuals ranged from 6.4 to 9.2 years[12,17-20].

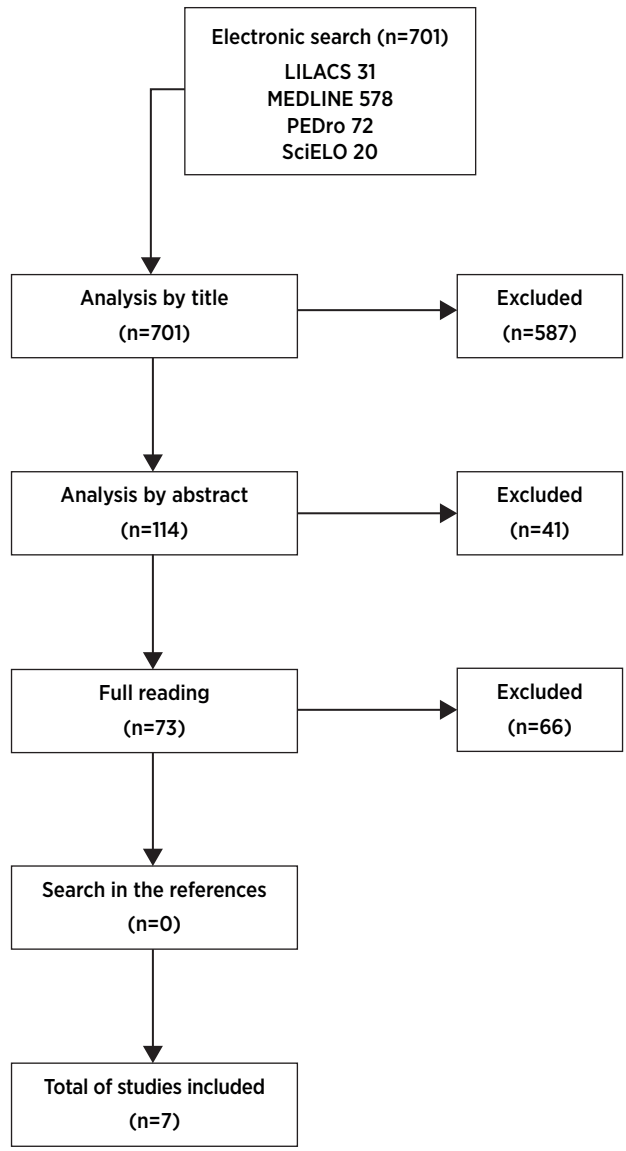

Figure 1. Flowchart of the search and selection of studies.
n: number of studies.

Regarding the outcomes of the studies, 85.7% analyzed balance[12,15-18,20], and most of them used the Berg Balance Scale (4/7; 57.14%)[15-18]. Other outcomes were also assessed (Chart 1). The measuring instruments used to assess the main outcomes (Chart 1) present appropriate properties and are recommended by the International Parkinson and Movement Disorder Society[23,24].

Chart 1. Summary of the characteristics of the sample and of the outcomes of the studies included (n=7)

Study (PEDro score)	Study design	N	Sex (M/F)	Age (mean±SD or age group) (years)	Outcomes assessed (numbers present the relation to assessment tool)	Assessment tools (numbers present the relation to the outcome assessed)
Esculier et al.[12] (4)	Experimental	11 PDWiit 9 CGWiit	6/5 PD 5/4 CG	PDWiit: 61.9±11.0 CGWiit: 63.5±12.0	Subjective perception of balance and fear of falling(1); Functional balance(2); Mobility in ADL(3); Static balance(4).	Activities-specific Balance Confidence Scale(1); Sit-to-Stand Test (2,3); Timed Up-and-Go(2,3); Tinetti performance-oriented mobility assessment(2); 10 meter walk test(3); Community Balance and Mobility Assessment(2,3); Unipodal support test(4).
Loureiro et al.[15] (3)	Quasi-experimental	6 PDWiit	NR	65±13.0	Subjective perception of effort(1); Static and dynamic balance(2); Quality of life(3); Functional range(4).	Borg Scale(1); Berg Balance Scale(2); Notthingham Health Profile(3); Timed-Up-and-Go(2); Functional Reach Test(4).
Pompeu et al.[16] (6)	Experimental	16 PDct 16 PDWiit	NR	60 to 85	Independence for ADL(1) Static and dynamic balance(2)	Unified Parkinson's Disease Rating Scale(1); Unipodal Support Test(2); Berg Balance Scale(2)
Mhatre et al.[17] (3)	Quasi-experimental	10 PDWiit	6/4	61.7 (44 to 91 years)	Dynamic balance(1) Static balance(2) Depression(3) Subjective perception of balance and fear of falling(4)	Dynamic Gait Index(1); Sharpened Romberg Test(2); Berg Balance Scale(1); Wii-Fit balance board(2); Geriatric Depression Scale(3); Activities-specific Balance Confidence Scale(4).
Zalecki et al.[18] (3)	Quasi-experimental	24 PDWiit	17/7	61.8 (43 to 80)	Functional balance(1) Mobility in ADL(2) Subjective perception of balance and fear of falling (3) Functional capacity(4)	Berg Balance Scale(1); Tinetti performance-oriented mobility assessment(1); Timed-Up-and-Go(2); Sit-to-Stand Test (1,2); ABC scale(3). 10 meter walk test(4).
Gonçalves et al.[19] (3)	Quasi-experimental	15 PDWiit	7/8	68.70±10.2	Motor function(1) Functional capacity(2)	Unified Parkinson's Disease Rating Scale(2); Schwab & England Scale(1); Functional Independence Measure(2).
Liao et al.[20] (9)	Experimental	12 PDWiit 12 PDct 12 PDwithout intervention	NR	PDWiit: 67.3; PDct: 65.1; PDwithout intervention: 64.6.	Sensory Integration(1) Quality of life(2) Fear of falls(3) Dynamic balance(4)	Sensory organization test(1); Parkinson's Disease questionnaire(2); Falls Efficacy Scale-International(3); Timed-Up-and-Go(4);

PDWiit: individuals with Parkinson's disease who underwent therapy with Wii technology; CGWiit: the control group composed of healthy individuals who underwent therapy with Wii technology; PDct: individuals with Parkinson's disease who underwent conventional therapy; NR: not reported.

Most of the studies (4/7;57.14%) presented score three in the PEDro scale (poor methodological quality)[15,17-19], were quasi-experimental (4/7; 57.14%) and used a group with pre- and post-test[15,17-19], followed by experimental studies with two groups: PD (Parkinson's disease) and GC (control group) (2/7; 28.57%)[12,16] and only one experimental study with three groups (1/7; 14.28%)[20] (Chart 1). Only one study conducted follow-up after the intervention period[16].

In all quasi-experimental studies in which balance was assessed[15,17,18], a significant improvement was observed with the use of Nintendo Wii (Chart 2). As to experimental studies, in the lowest score in the PEDro scale (4 in 11 points)[12], the static and dynamic balance improved, as well as the global mobility and functional abilities of the PD group when compared with the CG group. In the study by Pompey et al.[16] (PEDro=6), both groups with (conventional or with Nintendo Wii) balance training showed significant improvement in independence (UPDRS-II), without significant differences between the groups immediately

after or 60 days after the intervention. In the study by Liao et al.[20] (score 9 in the PEDro scale), significant improvements were reported in the PDWiit compared with the group without any intervention in the performance when crossing obstacles, in dynamic balance and in quality of life. In addition, the PDWiit group presented significant improvement in movement speed when compared with the PDct (Chart 2).

Chart 2. Synthesis of intervention protocols, results and conclusions of the included studies (n=7)

Study	Intervention Protocol	Results	Conclusion
Esculier et al.[12]	Training with the Nintendo Wii 40 min, 3x a week for 6 weeks for both groups.	The PDWiit showed significant improvement in the tests: unipodal support, COP, RMS, CBM, STST, TUG, 10MWT, POMA. The CGWiit showed significant improvement in the unipodal support test, CBM, STST, TUG.	Home training program using visual feedback with the Wii Fit can improve the static and dynamic balance, global mobility and functional abilities of individuals with PD.
Loureiro et al.[15]	Use of the Wii 20 min, 2x a week for 5 weeks.	The PDWiit showed significant improvement in the tests: Borg scale, Berg Balance Scale, Functional Range Conditioning to the right and to the left side.	Virtual reality therapy using the Wii Fit can improve the balance of individuals with PD.
Pompeu et al.[16]	PDct: conventional balance training, 60 min, 2x a week for 7 weeks; PDWiit: balancing training with Wii, 60 min, 2x a week for 7 weeks.	Both groups showed improvements in UPDRS-II. No difference between the PDct and PDWiit was found before, immediately, after or 60 days after the intervention.	Both groups improved their respective interventions without the intervention with the Wii showing a distinct result.
Mhatre et al.[17]	Training with the Wii 30 min, 2x a week for 8 weeks.	Significant improvement was found in the Berg balance scale, dynamic gait index and Sharpened Romberg test with eyes closed.	There was significant improvement in specific measures of balance and gait of individuals with PD.
Zalecki et al.[18]	Training with the Wii 20 minutes, twice daily, 7x a week for 6 weeks.	Significant differences in all tests were found after the intervention, except in the ABC scale.	Training with the Wii Fit has significantly improved the balance of individuals with PD.
Gonçalves et al.[19]	Training with use of the Wii 40 min, 2x week for 7 weeks.	Significant improvement was found in the scales Schwab & England; FIM and UPDRS III after training.	The training improved the motor function and functional capacity of individuals with PD.
Liao et al.[20]	PDWiit: 45 min of training with the Wii followed by 15 min of training on the treadmill, 2x a week for 6 weeks; PDct: 45 minutes of exercises of stretching, strength and balance followed by 15 min of training on the treadmill, 2x a week for 6 weeks.	The PDWiit showed better results in performance testing when crossing obstacles, in dynamic balance, SOT, TUG, FES-I and PDQ-39 than the control group.	The PDWiit significantly improved the performance at the intersection of obstacle and balance.

PDWiit: individuals with Parkinson's disease who underwent therapy with the Wii technology; CGWiit: the control group composed of healthy individuals who underwent therapy with the Wii technology; PDct: individuals with Parkinson's disease who underwent conventional therapy; STST: Sit-to-Stand Test; TUG: Timed-Up-and-Go; POMA: Tinetti performance-oriented mobility assessment; 10MWT: 10 meter walk test; CBM: Community Balance and Mobility; UPDRS-II: Unified Parkinson Disease Rating Scale Section II; ABC: Activities-specific Balance Confidence; FIM: Functional Independence Measure; SOT: Sensory Organization Test; FES-I: Falls Efficacy Scale-International; PDQ-39: Parkinson's Disease Questionnaire.

DISCUSSION AND CONCLUSION

The results of the studies included in this review suggest that the use of Nintendo Wii is effective to improve functional outcomes (balance, mobility, motor performance and independence) and health outcomes (decrease in the risk of falls and improvement of quality of life), being more consistent the evidence regarding the balance. A single study conducted follow-up after the end of the intervention and the results were positive for the continued improvement of the independence, both with conventional training and with Nintendo Wii. In other words, we did not identify better results with Nintendo Wii in comparison with conventional training.

The studies of this review included individuals with PD with more commonly described clinical and demographic characteristics[1] and used assessment tools to classify the severity of the disease, Hoehn & Yahr and UPDRS, which are commonly cited and recommended for assessment and staging of PD[25]. In quasi-experimental studies in which balance was assessed[15,17,18], the significant improvement observed

with Nintendo Wii (Chart 2) can be justified by the fact that Wii activities provide visual feedback to the postural response to movements of the center of gravity.

Although there are a great number of studies related to Nintendo Wii, only a few used it in individuals with PD, all published recently. Moreover, most of the studies had low methodological quality and are quasi-experimental, limiting thus the conclusions. It is important to consider that studies of this type are referred to as proof of concept and provide the first evidence that a new treatment can be effective in clinical situations, constituting phase I/II of experimental studies. This temporal sequence is recommended to answer some questions before conducting controlled studies[26]. Considering the results found in this review, this seems to have been the sequence used by experimental studies with Nintendo Wii in individuals with PD. Therefore, randomized clinical trials with follow-up of the intervention should be conducted with the aim to investigate the effectiveness of using the Nintendo Wii in individuals with PD.

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