

Effects of Virtual reality on balance and postural control in people with Multiple Sclerosis (A systematic review)

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Introduction

- MS characteristics
- Balance impairment in MS
- Falls in MS
- Ways of improve balance control
- Virtual reality
- Wii Fit

Characteristics of MS

- Impaired cognition, vision, strength and tone
- Impaired co-ordination, sensation
- **Balance and postural control disorders**

Balance impairment in MS



Decreased ability to maintain position



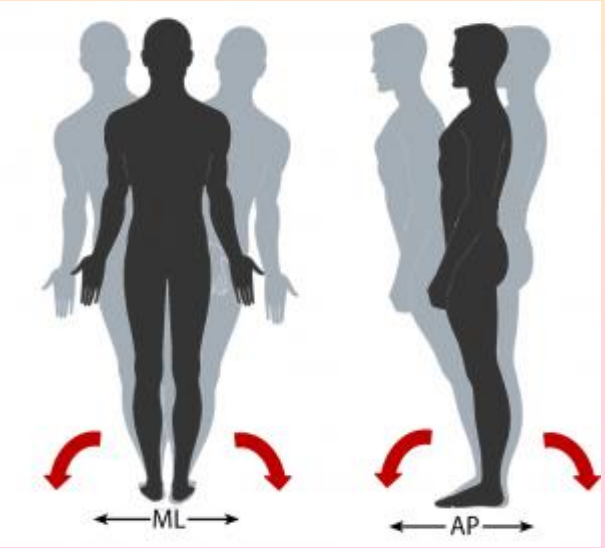
have limited and slow movement toward their limits of stability



have delayed responses to postural displacements or perturbations

Decreased ability to maintain position

- Sway more than healthy people
- Sway (Eyes closed)>(eyes open)
- Unable to maintain standing with a reduced BOS (tandem stance)



slow movement toward their limits of stability

- Move less far and less quickly (step/reach).
- had a significantly reduced COP displacement during voluntary leaning and reaching.

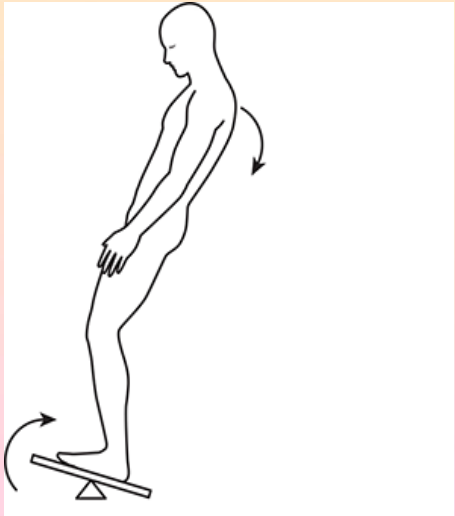
delayed responses to postural displacements

When the support surface move:

- Poor trunk control.
- Delayed postural responses.

Sitting on an unstable surface:

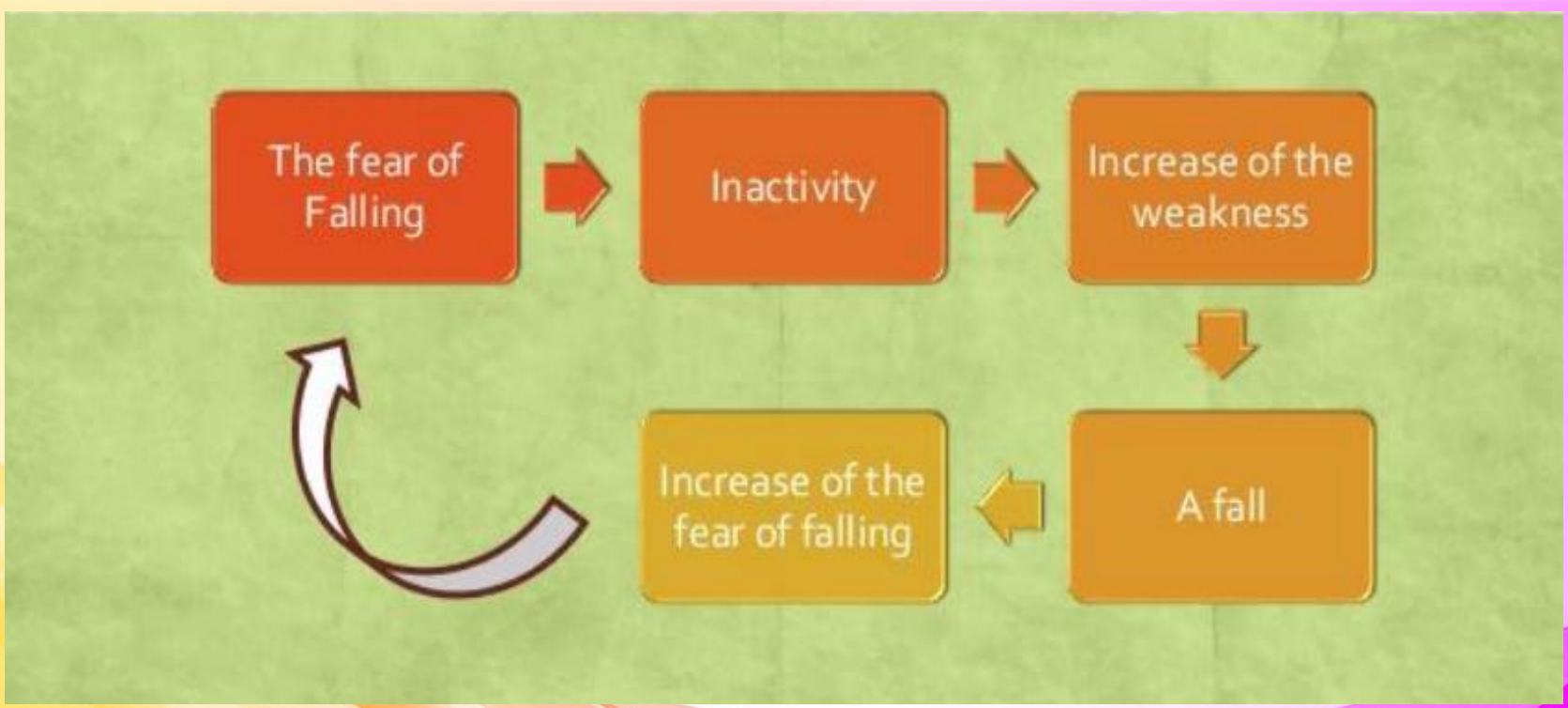
- Poor trunk control.



Falls in MS


fall
spasticity
Dual task conditions
Impaired central integration
Heat sensitivity
fatigue
Sensory impairments
Assistive device
Slowed somatosensory conduction

Fear of falling



Ways to improve balance control in MS

Usual approaches

- Motor and sensory strategies
- Feldenkrais exercises
- neuromuscular facilitation
- pharmacological

Neurorehabilitation

- Strengthening
- Balance training
- **VR**

Limitations of rehabilitation center

- Patients with MS have difficulties related to mobility and geographical location.
- Limitation of Personnel and material resources.
- Increase the cost of treatment.

Virtual reality



Virtual reality

- Involves real time stimulation and interactions through multiple sensorial channels.
- Using one or more of the 5 senses.
- High level of “acceptability”.
- Accessibility.
- Provide motivational activities.
- Track rehabilitation at home.

Mechanism of VR

Assist with a learning of new motor strategies:

Supply immediate feedback

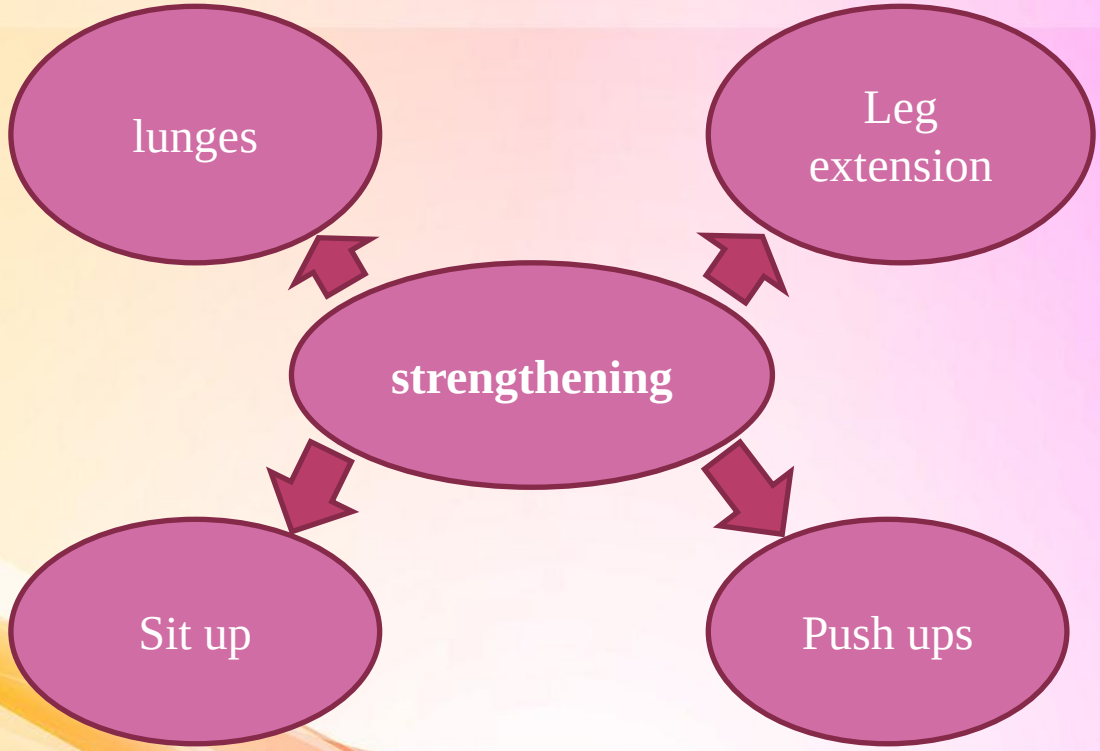
Walking in a crowded area.

Acceptable approximation of the real world.

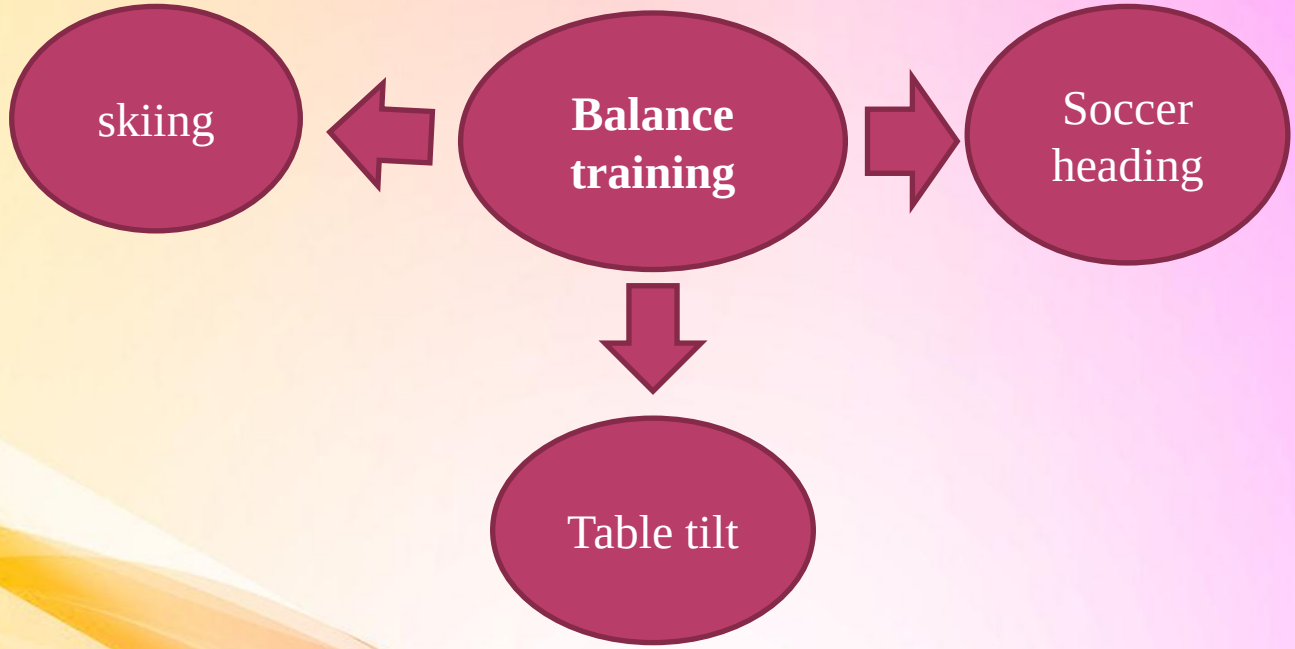
Beneficial for long term effectiveness of rehabilitation program.

Increase HR, VO2, EE

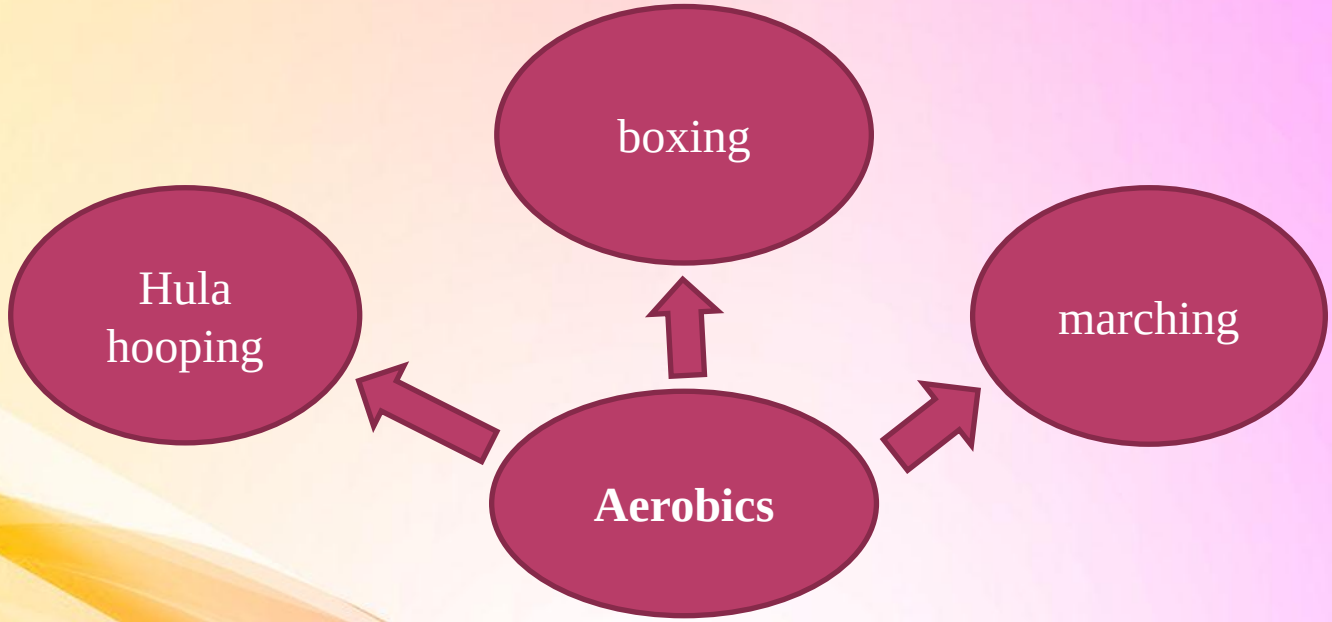
Wii Fit



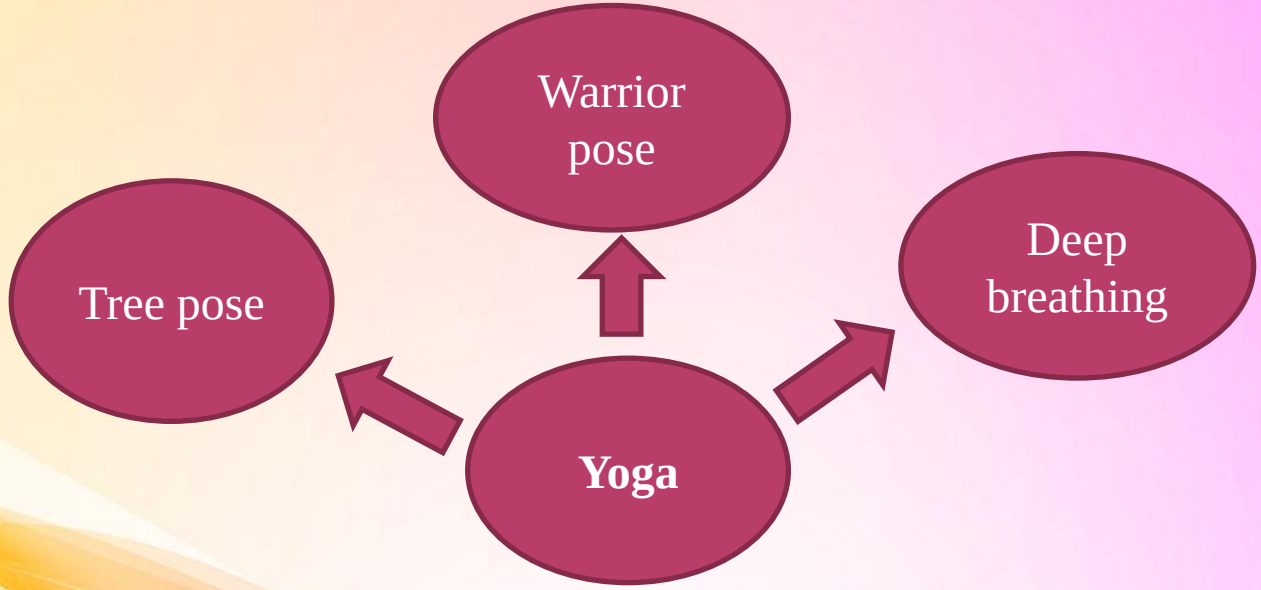
Wii Fit



Wii Fit



Wii Fit



Wii balance board

- The platform is pressure sensitive.
- Measuring the user's weight, displacement of COP and body mass.
- Uses Bluetooth.



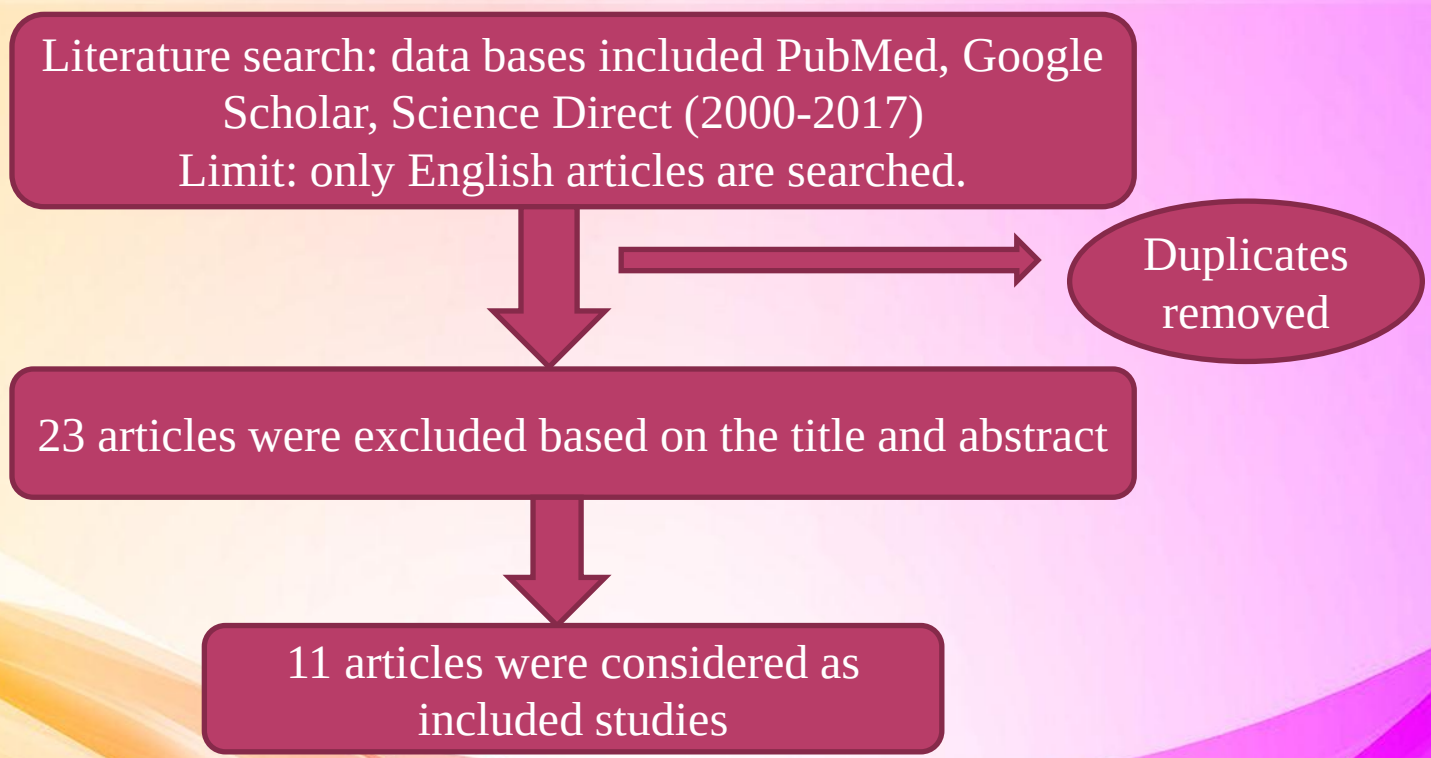
Advantages of Wii Fit for MS patients

- Reduce fatigue, Increase fitness level, Improve QOL.
- engage in exercise in their homes without expending unnecessary energy.
- foster socialization.
- fun to play
- foster intrinsic motivation.

Objective of the study

- Review the articles that consider the effects of virtual reality on balance and postural control of MS patients.
- If it could be an alternative method for traditional rehabilitation or not?

Flow diagram



Is there evidence??

no	Author/year	purpose	subjects	intervention	duration	Outcome measures	conclusion
1	Rosa Ortiz Guti´ errez, 2015	Evaluate the potential improvement in balance among patients with MS with VR rehabilitation program	50 patients with MS	Group1: telerehabilitation treatment(xbox) Group2: PT treatment (strengthening, proprioception, gait facilitation, muscle-tendon stretcchng)	10 weeks, 40 sessions	Berg balance and tinneti scores	Results showed an improvement over general balance in both groups. vestibular information, mean response time and Tinetti test yielded significant differences in the experimental group.

1





Mechanism of improved balance in EG

1. Increasing the level of practice in a distributed manner.
2. Increasing functional task repetition. (to repeat without repeating)
3. Sensory feedback modality used.

2	**Alon Karlon et al, 2016**	**examine the efficacy of a 6-week VR balance training program using the computer assisted rehabilitation environment (CAREN) system on balance measures in PwMS**	**32 pwMS**	**Group1: VR intervention Group2: conventional exercise program (static postural control, weight shifting and perturbations+stretching)**	**6 consecutive weeks, two sessions per week, 30 min sessions**	**COP path length/sway rate/ functional reach test/four square step test/the Fear of Falls self-reported questionnaire**	**significant differences in favor of the VR program were observed for the group x time interactions of the Functional Reach Test and fear of falling**
3	Ylva E Nilsagård et al, 2012	evaluate the effects of a Nintendo Wii Fit® balance exercise program on balance function and walking ability in people with (MS)	84 pwMS	Group 1:exercise (wii fit) Group2:no exercise	6-7 weeks, 12 sessions, 39 minute, twice a week	TUG, Dynamic Gait Index (DGI), Four Square Step Test	In comparison with no intervention, a program of supervised balance exercise using Nintendo Wii Fit® did not render statistically significant differences, but presented moderate effect sizes for several measures of balance performance

2 CAREN system

- **Motion Platform**
- **Projection**





4	**Giampaolo Brichetto et al, 2013**	**Assess the effectiveness of visual-feedback exercises in improving balance in MS**	**36 MS patients**	**Group 1:wii Group 2:traditional rehabilitation(static and dynamic exercises)**	**12 sessions (three 60-minute sessions/week)**	**Berg Balance Scale (BBS), Modified Fatigue Impact Scale, and sway area**	**Interactive visual-feedback exercises such as Wii could be more effective than the current standard protocol in improving balance disorders in MS.**
5	Luca Prosperini et al, 2013	evaluate the effectiveness of a home-based rehabilitation of balance using the Nintendo Wii Balance Board System (WBBS) in patients affected by multiple sclerosis (MS)	36 MS patients	Group1: 12-week period of home based WBBS training followed by a 12-week period without any Intervention Group2: treatment in reverse order	12 weeks, daily session, 30 minutes	force platform measures, 4-step square test (FSST), 25-foot timed walking test (25-FWT), and 29-item MS Impact Scale (MSIS-29)	A home-based WBBS training might potentially provide an effective, engaging, balance rehabilitation solution for people with MS.

6	**Hasan Tariq,2015**	**evaluate the effectiveness of Wii based balance interventions among Multiple Sclerosis people.**	**205 MS patients**	**Group1: Balance interventions by Wii balanced board. Group2: Control group with/without conventional Physiotherapy session of balance interventions**	**; 16 sessions, 30 minutes**	**Berg balance scale (BBS), Center of Pressured (COP), Four Square step test (FSST), Time up and Go test (TUG)**	**inclusion of Wii game in balance exercise on Multiple sclerosis people improve static balance more effectively as compare to dynamic balance in mild to moderate level of disability**
7	Andreas Kramer et al, 2014	To assess the effectiveness of and the adherence to an exergame balance training program with additional postural demands in patients with MS.	70 MS patients	Group1: exergame training Group2: conventional balance training	3 weeks, 9 sessions, 30 minutes	Balance tests, gait analyses,	Playing exergames on an unstable surface seems to be an effective way to improve balance and gait in MS patients, especially in dual task conditions.

8	**George D. Fulk, 2005**	**is to describe the use of plan of care that included locomotor training using both a body weight support (BWS) with a treadmill (TM) and overground walking as well as a virtual reality (VR)-based balance intervention to improve walking ability, balance, and endurance for an individual with MS**	**A single case with MS**	**BWS/TM system and over ground and VR-based balance interventions**	**12 weeks, 2d/w**	**gait speed, gait endurance, and balance post intervention**	**The client demonstrated improvements in gait speed, gait endurance, and balance post intervention and maintained the improvements at a 2-month follow up**
9	Jonathan Robinson, et al, 2015	to examine the effects of exergaming on: (1) postural sway, (2) gait, (3) technology acceptance and (4) flow experience in people with MS.	56 PwMS	Group1: balance training using the Nintendo Wii Fit™ (exergaming) Grouip2: traditional balance training group3: no intervention	4 weeks, 2d/w	Postural sway, Spatiotemporal parameters of gait, flow experience	In terms of the physical effects of exergaming, the Wii Fit™ is comparable to traditional balance training.

10	**Theresa R. Jones, 2016**	**whether virtual reality therapy using Xbox Kinect improves balance and postural control in MS.**	**62 PwMS**	**Group 1: kinect Group2: traditional physiotherapy**	**10 weeks, 1s/w,**	**(BBS), Tinetti balance scale, Single Leg Balance test (SLB), 10-Meter Walking test (10MW), and Time Up and Go test (TUG).**	**Virtual reality (VR) Kinect therapy is effective in improving balance and postural control in patients with MS. Although it should not replace conventional therapy**
11	Bina Eftekharsadat et al, 2015	to investigate the efficacy of a short-term virtual reality (VR)-based balance training program on the balance ability of patients with MS.	30 PwMS	Group1:balance training with biodex balance system Group 2:	3 trials of20 seconds	MMT, TUG, modifies ashworth scale, Romberg, BBS, postural stability tests.	According to the fall risk and postural stability tests results, the VR-based balance training could be an effective method for patients with MS.

Discussion

- In these reviewed articles, the number of subjects, outcome measures, type of games, therapy sessions and control group were different for example some of them used berg balance scale for comparison while others used posturography measures and etc.
- Although they have different methods but most of them suggest that VR balance training is very effective tool for rehabilitation in MS patients.
- For suggesting a protocol, it can be used 4 to 12 weeks, 3 sessions per week for about 30 minutes each session. Games that are the most popular are skiing, table tilt and soccer heading for this purpose.

conclusion

- Balance training based on virtual reality gaming could be an effective method for patients with MS. Additional search is needed to support the rehabilitation protocol with virtual reality and to solve their limitations and increase the effect of treatment.


Thank
You!