

# The Effect of Virtual Reality Training on Balance and Mobility in Adults with Moderate to Severe Traumatic Brain Injury: A Systematic Review

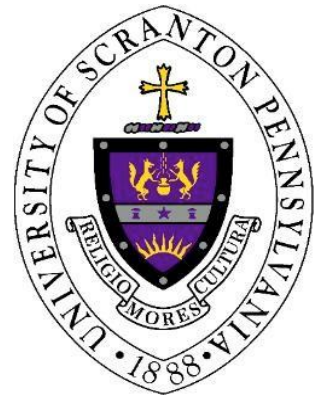
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# Overview

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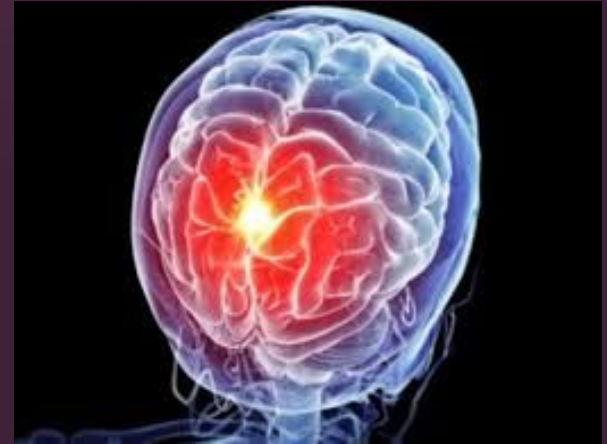
# Purpose

- The purpose of this systematic review was to determine if virtual reality training was effective at improving balance and mobility scores in adults with moderate to severe traumatic brain injuries (TBI)



# Definitions

- Traumatic brain injury (TBI)<sup>1</sup>
  - Brain tissue damage caused by compression, shearing or a combination of both following acceleration, deceleration or rotational forces on the head due to an outside impact



# Definitions

- Virtual reality (VR)<sup>2</sup>
  - Computer based processes providing a simulated environment that can be used for real-time interaction and reactions to changes in the environment
  - i.e. Xbox Kinect, PlayStation and Wii<sup>2,4,6</sup>



# Definitions cont.

- eBaVIR - easy Balance Virtual Rehabilitation
  - Based on the Nintendo Wii Balance Board System
  - Does not use traditional commercial software
  - Weight transfers in seated and standing that actively involve the patient
  - Calibrates and adapts to the subjects range and impairments



# Definitions cont.

- CAREN - computer assisted rehabilitation environment
  - Consists of a motion platform surrounded by a 10-ft tall screen and dual-belt treadmill that measures the ground reaction forces
  - Platform that challenges subjects physically and cognitively by being fully immersed
  - Programmed to move in synchronization with the treadmill and platform



# Methods

- A literature search was conducted including:
  - CINAHL
  - HealthSource: Nursing/Academic Edition
  - Medline/PubMed
  - ProQuest Central
- Two reviewers independently assessed each study using the PEDro scoring system





# Methods cont.

- Search terms
  - ("brain injury" OR "traumatic brain injury") AND ("virtual reality" OR gaming OR wii OR kinect) NOT concussion



# Methods cont.

- Search limits
  - Peer-reviewed
  - Published between 2008-2018
  - Adults aged > 18 years
- Selection Criteria
  - Virtual reality
  - Moderate to severe TBI
  - Randomized control trials



# PRISMA

Identification

Screening

Eligibility

Included

Records identified through database searching (n= 326)

Records identified through other sources (n=0)

Records after duplicates removed (n= 248)

Records screened by title and abstract (n= 248)

Records excluded (n= 229)  
-Not adults (n= 52)  
-Not TBI (n= 78)  
-Not balance/mobility (n= 99)

Full-text articles assessed for eligibility (n=19)

Full-text articles excluded, with reasons (n=14)  
-Not randomized control trials

Studies included (n=5)



# PEDro Scores

	Random Allocation	Concealed Allocation	Baseline Comparison	Blind Subjects	Blind Therapists	Blind Assessors	Adequate Follow Up	Intention to Treat	Between Group Comparison	Point Estimate Variability	Score
<b>Straudi et al</b>	Y	N	Y	N	N	N	Y	Y	Y	Y	<b>6/10</b>
<b>Sessoms et al</b>	Y	N	Y	N	N	N	Y	Y	Y	Y	<b>6/10</b>
<b>Gil-Gomez et al</b>	Y	N	Y	N	Y	Y	Y	Y	Y	Y	<b>8/10</b>
<b>Cuthbert et al</b>	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	<b>9/10</b>
<b>McClanahan et al</b>	Y	N	Y	N	Y	Y	Y	Y	Y	Y	<b>8/10</b>

# Results

- 326 articles were screened for eligibility
  - 5 met the criteria for final inclusion<sup>2-6</sup>
- Average PEDro score of 7.4
- Sample sizes ranged from 11-26 subjects
- Subjects range from 19 -75 years old
- Studies occurred over 4-6 week time period
- Treatment sessions ranged from 15-60 minutes



# Results cont.

- All five studies found improvements in balance and mobility scores<sup>2-6</sup>
- Statistically significant improvements across studies included:
  - **TUG score: average change of 2 seconds<sup>3,6</sup>**
  - Berg Balance Score: average change of 4.22 points<sup>3</sup>
  - 30 Second Sit to Stand: average change of 1.44 repetitions<sup>3</sup>
  - **Community Balance and Mobility Scale: average change of 8 points<sup>6</sup>**



# Interventions

<b>Treatment</b>	<b>Duration</b>
15 minutes of balance therapy (8 minutes balance board and 7 minutes WiiSports) in addition to standard therapy <sup>2</sup>	4 times/week 4 weeks
1 hour of eBaViR therapy (virtual rehabilitation system for balance recovery) with 3 different games <sup>3</sup>	3-5 times/week 20 sessions total
30 to 60 minutes of either usual therapy or usual therapy plus WiiFit balance therapy <sup>4</sup>	3 times/week 4 weeks
20 to 30 minutes of either half traditional therapy/half CAREN or all CAREN therapy <sup>5</sup>	2 times/week 6 weeks
1 hour of either standard balance therapy or video game therapy <sup>6</sup>	3 times/week 6 weeks



# Conclusion

- There is moderate to strong evidence that the use of VR as an adjunct intervention can improve balance and mobility in patients with TBI
- The most clinically significant findings were found in the TUG and CB&M scores using eBaViR and WiiFit systems
- Most effective outcomes were found with sessions greater than 20 minutes over the course of 6 weeks





# Limitations

- Small sample size
- Varied use of outcome measures and protocols for balance and mobility
- Not all of the subjects were exclusively patients with TBI
- Of the 5 studies, 3 used commercially available equipment <sup>2,4,6</sup> and 2 used custom VR technology <sup>3,5</sup>



# Clinical Relevance

- Commercial VR systems (i.e. Wii and Xbox Kinect) are readily available to clinicians
- VR can be an effective adjunct intervention to improve balance and mobility performance in patients with TBI
- Promote adherence to patient's plan of care and increased patient enjoyment



# Recommendations

- Future research should consider:
  - Larger sample sizes
  - Patients with exclusively TBI
  - More uniform tests and measures to determine optimum VR protocols



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- DPT Faculty and Students



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Thank You!  
Questions?

# Appendix



# Psychometrics

<b>Outcome Measure<sup>7</sup></b>	<b>Condition<sup>7</sup></b>	<b>MDC/MCID<sup>7</sup></b>
BBS	Acute stroke	6.3 pts
BBS	Chronic stroke	2.5-4.66 pts
TUG	Chronic stroke	2.9 seconds
FGA	Stroke	4.2 pts (5pts clinically)
BBA	Stroke	1 pt out of 12
FRT/ART	Acute Stroke	3.7 cm
FRT/ART	Subacute Stroke	6.79 cm
2 min walk test	Brain injury	16.4 m ~ 53.8 ft
10 min walk test	Brain injury	>.05 seconds is > rater error
Common balance and mobility scores	Brain injury	7.5-9.6 pts

