Effects Of Virtual Reality Training on Balance Function In Older Adults with Cognitive Impairment

Yi-Cheng Cathy Lin
M.S., P.T.
Introduction

- Cognitive impairment includes the memory dysfunction, behavioral change and impaired executive function

- People with cognitive impairment
  - Balance dysfunction (Stark et al., 2013)
    - Showed in very early stage of cognitive impairment
  - Gait deviation in dual task (Gillain et al., 2009; Maquet et al., 2010; Pettersson, Olsson, & Wahlund, 2007)
    - Gait variability increased
    - Walking speed decreased
  - High incidence of fall (Kallin, Gustafson, Sandman, & Karlsson, 2005; Shaw, 2002; van Doorn et al., 2003)
    - Almost twice as high as the people without cognitive impairment

- Balance ability in patients with cognitive impairment had improved after balance training (Ries, Drake, & Marino, 2010)
Virtual reality (VR) balance games were effective training programs to improve balance function

- Healthy elderly (Franco, Jacobs, Inzerillo, & Kluzik, 2012)
- Patients with neurological disease
  - Stroke, Parkinson disease (Barcala et al., 2013; dos Santos Mendes et al., 2012)

However, the effect of VR balance training to improve both balance and cognitive functions in patient with cognitive impairment is still limited.
To investigate the training effects of VR program on balance and cognitive functions in the older adults with cognitive impairment.
Methods

- **Participants**
  - Patients with mild cognitive impairment (MCI) and mild dementia in day care center in Taichung, Taiwan

- **Inclusion criteria**
  - Age: 45 to 85 years
  - Diagnosed of mild to moderate cognitive impairment or Alzheimer’s disease
  - No diagnosis of depression
  - No Symptoms or history of other system problems which would affect their physical activity
Training Program

- VR balance training
  - Nintendo “Wii Fit”
  - Training protocols include stability and dynamic weight shifting training
  - 30 minutes x twice/week for 6 weeks
- Warm up and cool down were performed before and after training
- Programs were downgrade or upgrade based on the participant’s performance
Nintendo “Wii Fit” Training

A. Lotus Focus
• Participants need to hold standing stability on the platform.

B. Penguin Slide
• Participants have to shift body weight to tilt the iceberg to left or right to eat as many fish as possible in the a limited time.

C. Bubble Balance River
• Players were required to steer the bubble through a hazard-filled by shifting their body weight while standing on the balance board.

D. Table Tilt
• Tilted a board to roll marbles into holes by shifting their body weight. They had to carefully manipulate the board to roll the balls into the holes without dropping a ball off the table.
Training Procedure
Neuropsychological Tests

- **General cognitive function**
  - Mini-Mental State Examination (MMSE)
    - Total score: 30

- **Executive Function**
  - Color Trail Test (CTT)
    - Part 1 and part 2
    - Index: completion time
Berg Balance Scale (BBS)

- Measure balance among older people with impairment in balance function by assessing the performance of functional tasks
- 14-item scale
- Interpretation:
  - 41-56 = low fall risk
  - 21-40 = medium fall risk
  - 0 –20 = high fall risk

ITEM DESCRIPTION

- Sitting to standing
- Standing unsupported
- Sitting unsupported
- Standing to sitting
- Transfers
- Standing with eyes closed
- Standing with feet together
- Reaching forward with outstretched arm
- Retrieving object from floor
- Turning to look behind
- Turning 360 degrees
- Placing alternate foot on stool
- Standing with one foot in front
- Standing on one foot
Statistical Analysis

- Comparison within group
  - Repeated measure of general linear model (GLM)
  - Pre-training, post-training (week 6), follow up (week 12)

- SPSS version 16
  - Significant level, $\alpha = 0.05$
## Basic Characteristics of Participant

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD or N</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N=12</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>75.06±5.94</td>
<td>64.3~84.1</td>
</tr>
<tr>
<td>Gender (F/M)</td>
<td>11/1</td>
<td></td>
</tr>
<tr>
<td>Educational level (years)</td>
<td>5.78±2.68</td>
<td>0~9</td>
</tr>
<tr>
<td>MMSE</td>
<td>17.33±5.19</td>
<td>8~24</td>
</tr>
</tbody>
</table>

**MMSE:** Mini-Mental State Examination
Training Effect on Executive Function

Color Trail Test part 1

Color Trail Test part 2

Completion Time (sec)

Pre
Post
Follow up

Time

Completion Time (sec)

Pre
Post
Follow up

Time

* indicates statistical significance.
Training Effect on Balance Function

Berg Balance Scale

- Pre
- Post
- Follow up

* Significant difference
Discussion

- Six-week balance training using virtual reality (Wii-fit) programs for the older adults with cognitive impairment shows significantly
  - Decreased completion time of part 1 and 2 of Color Trails Test (CTT1 & CTT 2)
    - Involving the abilities of perceptual tracking, sequencing, sustained attention, and divided attention
  - Improved score of Berg Balance Scale (BBS)
    - Involving the abilities of static/dynamic sitting and standing postures, weight shifting and limits of stability
Wii-Fit program training show a significant improvement in both sustain and divided attention after 6-week training.

- Interaction with VR programs provides the activity of cognitive level.

Consistent with the results of previous studies, balance games by Wii-Fit training could improve balance function (Padala et al., 2012; Bieryla, 2013; Doque et al., 2013).

- Wii-fit training forces participants the awareness of center of pressure and limit of stability with real-time visual feedback.
Lack Retention Effect and Limitations

- Only CTT 2 showed significant retention effect at 12-week follow up
- Small sample size
- No control group
Conclusion

- Balance training with Wii-Fit exercise programs is safe and effective to improve cognitive and balance functions for the older adults with cognitive impairment.

- The exercise should be sustained for maintenance of training effects for the older adults with cognitive impairment.
Acknowledgement

- Dr. Hsiu-I Chen, Dr. Yu-Hsiu Chu
- HungKung University and Kuang Tien General Hospital
  - Grant support: HK-KTOH-104-07
- Research assistant
  - Xiao-Han Chiu, Jia-Ying Chen
- All participants
Thank you for your attention!!