The Effects of Intensive Wii Sport Training on Adolescents with Spastic Diplegic Cerebral Palsy: Case Study

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Abstract

Introduction: The aim of the present study was to investigate the effects of Wii Sports training on balance, Walking speed, Visual-Motor Integration, and independent standing of two adolescents with spastic diplegic Cerebral Palsy (CP). **Materials and Methods:** Two adolescents with spastic diplegic CP who had Gross Motor Function Classification System (GMFCS) level III participated in intensive Wii Sports training program for two weeks. The Visual-Motor Integration (VMI), Berg Balance Scale (BBS), walking speed, and independent standing time scores were recorded before the intervention and at the end of 12 training sessions. Two adolescents with spastic diplegic CP who had Gross Motor Function Classification System (GMFCS) level III participated in intensive Wii Sports training program for two weeks. The Visual-Motor Integration (VMI), Berg Balance Scale (BBS), walking speed, and independent standing time scores were recorded before the intervention and at the end of 12 training sessions. **Results:** Both adolescents demonstrated improvements in the VMI, BBS scores, durations of independent standing, and walking speed. **Conclusions:** Wii is a low-cost gaming system that can be effective in adolescents with spastic diplegic CP with GMFCS level III, yet further studies are required for definitive claims.

Key words: Balance ; Cerebral palsy; Wii sport

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Introduction

Cerebral Palsy (CP) is a group of disorders of movement and posture, causing activity limitation and is related to non-progressive disturbances occurring in the developing fetal or infant brain (1). Children with CP suffer from motor and cognitive disabilities, which usually need a multi-faceted treatment strategy over many years involving a number of different health professionals (2). One of these professionals is occupational therapists.

Essential components of effective motor learning which are valuable to occupational therapist are the child's active participation in therapy and the goal-oriented movement. These components may be provided through the playing an interactive game (3).

Virtual rehabilitation is a relatively new method in CP treatment that provides CP patients the opportunity to play an interactive game. In the recent years, there has been increasing interest in the use of the Nintendo Wii and Wii Fit (Wii) as virtual rehabilitation tools. This active video games system may allow children with CP to perform many types of activities they cannot do in the real world.

There are few studies that investigated the effect of Nintendo Wii and Wii Fit in the rehabilitation of children with CP, for example, the impact of Wii on balance in children with ambulatory CP (hemiplegia, diplegia, diskinetic) (4), its impact on balance and gross motor function for children with spastic hemiplegic CP (3), and as an additional instrument in the rehabilitation of an adolescent with diplegic CP (5). Despite the differences in the intervention period and type of CP, in all the aforementioned studies, positive effects were observed.

In the schools for children with special needs, adolescents with CP have little opportunity for physical activity. In addition, space restrictions do not allow the possibility of doing various sports. Thus, the aim of the current study was to investigate the effects of Wii on motor function of patients with CP in these settings.

Materials and Methods

Two adolescents with CP spastic diplegia were recruited from the Tavankhahan School of Iran, Tehran, during August 2014. The inclusion criteria were a) level 1–3 of the Manual Ability Classification System for adequate functional hand skills to use Wii remotes, b) level 1-3 of the Gross Motor Function Classification System, c) no history of surgery or botulinum toxin application to the upper extremity in the previous 6 months, and d) normal or mild level intellectual disability for the adequate cognitive ability to follow directions. Parents signed an informed consent form prior to the study.

Several measures were used to characterize participants' motor control profile. Test of visual-motor integration, balance, walking speed, and independent standing time were administered as outcome measures.

Test of Visual-Motor Integration (TVMI) is used by occupational therapists to assess the degree of visual-motor integration dysfunction in pediatric clients. In this test, a geometric figure is shown to the children and they are asked to copy it in a designated space. The TVMI is designed for children aged 4 to 17 years and comprises 30 geometric figures (6). Walking speed was measured using 10-meter walking test. In this test, individual walks for 10 meters and the walking time is measured. Also, Berg Balance Scale is a clinical measure of balance in children with CP. The test takes 15–20 minutes and consists of 14 items, ranging from standing up from a sitting position to standing on one foot. Each item has ordinal scoring from 0-4 and the final measure is the sum of all the scores, ranging between 0-56 (7).

We used Wii sports games software that can be performed in both sitting and standing positions and that provides users with knowledge of performance and results. An occupational therapist supervised and supported the patients during the therapy sessions. To ensure the safety of participants, the therapist supported the child's back. According to the therapeutic goals, Wii Sports Boxing, Baseball, Tennis, and bowling games were selected. During these games, participants can practice eye hand coordination, trunk control, balance, and unilateral and bilateral movements of the upper extremity. Participants played the Nintendo Wii Fit game for 45 minutes/day for two weeks. They were evaluated prior to and two weeks after the intervention.

Results

One of the participants was a 10-year-old adolescent. She was ambulating independently with orthotic shoes and a walker for short distances at home and school. Standing posture included kyphosis with hip and knee flexion. Sitting posture included hip lateral rotation and flexion and knee flexion. She was at a level III of the GMFCS and level II of the MACS.

The second participant was a 16-year-old girl. She was walking independently with bilateral ankle-foot orthoses and walker. Standing posture included kyphosis with hip abduction. She was at a level III of the GMFCS and level II of the MACS.

Participants had a mild level intellectual disability according to their health records and were able to follow directions, stay on task, and understand the games. Both of them used glasses because of refractive error. They had adequate functional hand skills to manage the Wii remotes and gross motor skills to work in either a sitting or standing position.

The results showed that both participants had improvement in all outcome measures (Table 1). In participant 1, the greatest changes were seen in balance, independent standing time, and walking speed (114%, 104%, and 95%, respectively). Moreover, visual-motor integration had the slightest change (38%). In participant 2 the greatest changes were seen in independent standing time, walking speed and visual-motor integration (360%, 92%, and 62%, respectively) and the slightest change in balance.

Discussion

The results of the present study indicated that a two-week period of intensive daily Wii practice (12 sessions) improved walking speed, visual-motor integration, balance, and independent standing time of two adolescents with spastic diplegia.

Balance improved in both participants (58-114%), but further changes were observed in the participant 1. It is reported that children achieve the maximum level of balance skill at 12 years of age (8). Maybe that is why participant 2 (16 years old) changed less compared with participant 1. However, the current study showed that, at this age, there is also the possibility of improving the balance. Increase in the balance after the use of Wii games was already mentioned in the previous studies (3, 4, 8, 9).

Walking speed in both adolescents improved (92-95%). This could be due to the improvement of balance. In children with spastic diplegic CP, step width was larger due to poor balance and gait instability. In addition, the duration of single-limb support was shorter, and double-limb support was longer so they walk slowly (10). Liao HF *el al.* suggested that rhythmic weight-shift training improve the walking performance of children with CP (11). During Wii games (for example, tennis and boxing) participants experienced trunk control and weight shifts. Significant increase of independent standing time (104-360%) is also another reason to improve balance and walking speed.

There was little change in the visual-motor integration scores of participant 1 (38%) compared with those of participant 2 (62%). The visual-motor integration involves visual perception and eye-hand coordination (12). Games used in the present study (such as bowling, tennis, and baseball game) were supposed to increase eye-hand coordination. So, increase in visual-motor integration was not unexpected. It seems that intervention is more effective in participants with lower scores.

Of course, there is the possibility that two participants were different in terms of visual perception. This finding is consistent with that reported by Deutsch *et al.* (5). They reported improvement in visual-perceptual processing in an adolescent with spastic diplegic CP after 11 Wii training sessions.

Chiu and Kuo suggested that virtual reality could be useful as a supplement of intervention, especially for those who have difficulties in real environments (13). Participants in the present study did not use the rehabilitation program as they had time limitation and were busy with their studies. The results of the current study showed that intensive training of Wii games alone can improve balance, walking speed, independent standing time, and visual-motor integration in adolescents with diplegic CP. To the authors' knowledge, this is the first published report on using the Wii system for rehabilitation of CP in Iran. Wii offers an inexpensive alternative to more complex systems for children with CP. Since the advantage of playing Wii games as home rehabilitation has already been approved in children with CP spastic diplegia (14), this game can be provided for special schools to help children who cannot do sports activities because of physical problems in exercise classes or at home.

Limitations

The most important limitation of the present study is the small sample size that could have affected generalizability. The current research was carried out on two adolescents with diplegic CP whose GMFCS level was III. The results cannot be extended to other group of CP or other GMFCS levels, because of the difference in the abilities of each group. Moreover, another test measuring visual perception should have been administered to sustain these results.

Conclusion

In conclusion, the present study showed that intensive Wii sport training can improve walking speed, visual-motor integration, balance, and independent standing time of adolescents with spastic diplegia (GMFCS level III). However, more research is needed to reach a definitive conclusion.

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All authors made substantial contributions to conception, design, acquisition, analysis and interpretation of data.

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