Research in Developmental Disabilities 38 (2015) 256–261

Contents lists available at ScienceDirect

Research in Developmental Disabilities

# Effects of an eight-week whole body vibration on lower extremity muscle tone and function in children with cerebral palsy

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ARTICLE INFO

*Article history:*
Received 4 November 2014
Accepted 9 December 2014
Available online 7 January 2015

*Keywords:*
Cerebral palsy
Spasticity
Whole body vibration
Ambulation
Rehabilitation

ABSTRACT

The aim of this study was to evaluate the effect of an eight-week whole body vibration (WBV) on lower extremity spasticity and ambulatory function in children with cerebral palsy with a complete crossover design. Sixteen participants aged 9.2 (2.1) years participated in this study. Half of the participants received a 10-min WBV, 3 times a week for 8 weeks. Then a 4-week washout period followed, after which they received a sham WBV 3 times a week for 8 weeks. The other half received the intervention in a reversed order. The participants were evaluated via variables measuring range-of-motion, muscle tone, and ambulatory function before, immediately after, 1 day after, and 3 days after each intervention. Repeated-measures analyses revealed significant beneficial effects on most variables expect the passive range-of-motion measurement. Significant correlations were found between timed up-and-go and relaxation index, and between timed up-and-go and six-minute walk test. The results suggested that an 8-week WBV intervention normalized muscle tone, improved active joint range and enhanced ambulatory performance in children with cerebral palsy for at least 3 days. These indicated that regular WBV can serve as an alternative, safe, and efficient treatment for these children in both clinical and home settings.



## 1. Introduction

Cerebral palsy (CP) is the most common childhood disabilities which affect individual's posture and movement (Koman, Smith, & Shilt, 2004). Compared to the typically developed children, these children have impaired sensation and increased muscle tone therefore they have trouble voluntarily controlling their muscles. About seventy to eighty percent of children with CP demonstrate spastic clinical features (Krigger, 2006). Traditionally spasticity is managed via anti-spastic medication

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http://dx.doi.org/10.1016/j.ridd.2014.12.017
0891-4222/

or injection. Several disadvantages are associated with these treatments. First, not all patients achieve satisfactory results, and not all parents are comfortable with long-term medication use or invasive injection. In addition, there are side effects such as general weakness that in turn affect their functional performance. As a result, there is a need for alternative or additional treatment options.

Other than spasticity, poor muscle strength is also an important factor that leads to movement dysfunction in CP (Damiano, Martellotta, Sullivan, Granata, & Abel, 2000). The weak quadriceps in this population inevitability impaired their walking performance (Damiano, Kelly, & Vaughn, 1995). These days whole body vibration (WBV) has become popular in local gym and fitness centers, and it was found to offer fitness and health benefits, including flexibility and muscle strength (Dolny & Reyes, 2008; Kosar, Candow, & Putland, 2012; Rittweger, 2010). Recently, it seems to reach satisfactory results in managing spasticity and muscle strength among participants with upper motor neuron syndrome (Ahlborg, Andersson, & Julin, 2006; Chan et al., 2012; Ness & Field-Fote, 2009).

Whole body vibration (WBV) is a training method which exposures the whole body of an individual to low frequency, low amplitude mechanical stimuli via a vibrating platform. The vibration stimulate the muscle spindles, sending nerve impulses to initiate muscle contractions according to the tonic vibration reflex (Cardinale & Bosco, 2003). Its effects on enhancing health and fitness in general population have been studied extensively; however, little was done with special groups, for example children with CP. Ruck, Chabot, and Rauch (2010) examined the effects of a 9-min WBV program on children with CP and found their mobility improved (Ruck et al., 2010). In this particular study, the only indicator for mobility was the change in self-selected walking speed (Ruck et al., 2010). Unger, Jelsma, and Stark (2013) investigated the vibration on trunk muscle strengthening and found beneficial effects onto posture and gait. Other than the postural related measurements, there was only one gait parameter, the 1-min walk test, assessed (Unger et al., 2013). Furthermore, the direct effect on spasticity was never evaluated.

Ahlborg et al. (2006) performed a comprehensive survey of spastic, strength, and walking variables after an 8-week WBV or an 8-week resistance training in adult with CP (Ahlborg et al., 2006). They found WBV was more effective in decreasing spasticity of the knee extensors compared to the resistance training. Leg muscle strength increased in both groups. On the other hand, the ambulatory parameters did not change significantly. Although this study demonstrated an extensive investigation on the effects of WBV on CP, there were aspects that can be improved. First, findings of the study were gathered from adults with CP, not children. Children usually demonstrate a better potential in functional improvement, therefore studies with children as subjects are of great needs. Second, this study had no control group. A control group provides true baselines for all testing variables, and this becomes substantially important when dealing with children. Third, when isokinetic strength was measured before ambulatory parameters, the muscle exertion would hinder the effects of WBV on ambulation. Last, the study only measured immediate influences, no lasting effects were evaluated.

Therefore, the aim of this study was to evaluate the immediate and lasting effects of WBV on lower extremity spasticity and ambulatory function in children with CP. It was hypothesized that upon the completion of this 8-week program, the spasticity among these CP children would decrease significantly and their ambulatory function would improve.

## 2. Materials and methods

A crossover repeated measures design was employed in this study. Sixteen children with CP were randomly divided into two groups. One group received an 8-week WMV intervention followed by an 8-week control condition, with a 4-week rest in between; the other group began their treatment sequence with the control condition to counterbalance the order effects (Fig. 1). The outcome variables included active and passive range-of-motion (AROM and PROM) of both knees, relaxation

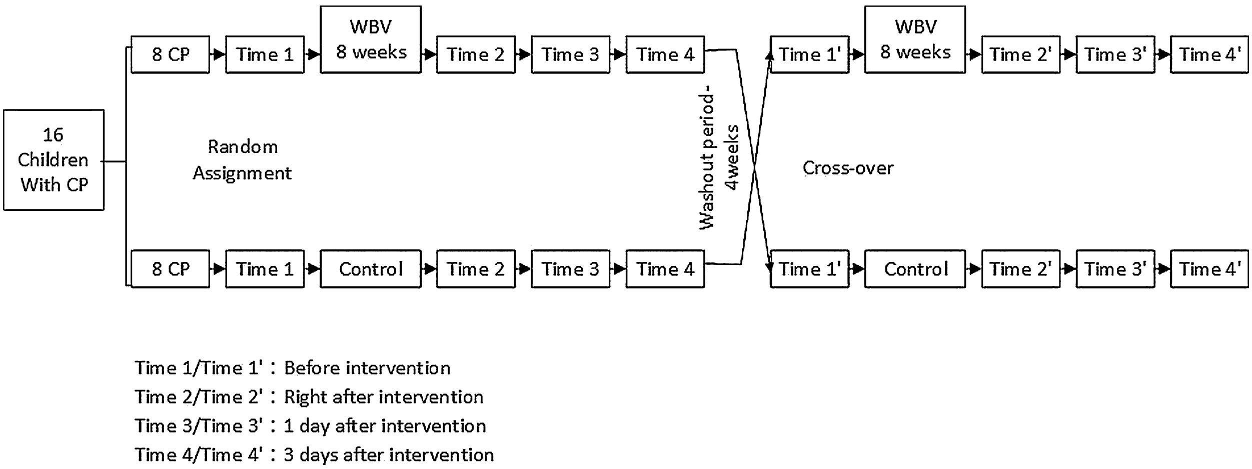


**Fig. 1.** Flow chart of the crossover design.