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Review article

Effects of long-term whole-body vibration training on mobility in patients with multiple sclerosis: A meta-analysis of randomized controlled trials

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ABSTRACT

Background: This meta-analysis evaluated feasibility and efficacy of long-term whole-body vibration (WBV) training in improving mobility of multiple sclerosis (MS) patients.
Methods: The primary search of this meta-analysis was conducted from four electronic databases (PubMed, Sport, CINAHL and Cochrane) in order to find all relevant randomized, controlled WBV intervention trials of MS patients published between January 2000 and October 2013. The primary search was complemented by a recent (Aug 2015) PubMed search. Data on patients' characteristics and type of WBV intervention were extracted from the published reports and supplementary material. Two researchers independently assessed the methodological quality of these studies and outcomes. Standardized mean differences based on the baseline-adjusted follow-up results were calculated as indicators of the effect size (ES) of WBV training.
Results: Seven randomized controlled trials (RCTs) involving 250 MS patients were found. Relevant group-based data for analysis were available from 109 patients in WBV groups and from 100 control patients; 41 patients withdrew from the studies. Quality assessment revealed that the WBV training protocols were heterogeneous and the methodological quality of the studies was generally poor. We found borderline indication for improved 2–6 min walking endurance [ES = 0.25 (95% CI = −0.06–0.0.55)] favoring WBV training whereas no benefits were indicated for short-distance (20 m or less) walking speed or balance.
Conclusion: This meta-analysis suggests that WBV training has potential in improving walking endurance in MS patients with low disability status. However, evidence for more severely disabled MS patients is lacking, and further well-designed, long-term RCTs with adequate sample sizes are needed.

Contents

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1. Introduction

Multiple sclerosis (MS) is a progressive inflammatory and disabling autoimmune disease of the central nervous system [1]. This condition leads to declined physical function manifest as slower walk, ataxia, poorer balance, spasticity and muscle weakness [2]. Consequently many MS patients suffer from reduced mobility, quality of life and work ability [3]. The curative treatment against MS has not yet been found but with proper supportive pharmacotherapy, rehabilitation and lifestyle best results are attained. In rehabilitation of MS, physical therapy is the key element but also aerobic and resistance exercises have resulted in positive effects [4–7].

Whole-body vibration (WBV) has been used in clinical rehabilitation of elderly people over a decade [8]. WBV training is mainly based on synchronous vertical or side-alternating oscillation generated at specified frequency and amplitude [8]. While standing on the oscillating platform, vibration transmits to the body trough feet while muscle spindles cause contractions that lead to so-called tonic vibration reflexes [8,9]. Training effects of WBV have been investigated in various target groups from competitive athletes to institutionalized elderly people, and benefits have been found in muscle power and strength, dynamic performance, balance and bone mineral density [10–13]. WBV has also been applied to neurological patients with Parkinson disease, cerebral palsy, stroke or MS [14–22]. In general, WBV may offer some benefits on muscle power, swinging, tremble, spasticity and rigidity of the body and complement thus the repertoire of methods used for physical rehabilitation of neurological patients. For the MS patients, however, the evidence is yet quite limited; only two long-term WBV trials were included in the previous meta-analysis [20].

The purpose of the present meta-analysis was therefore to update the current available knowledge about the effects of long-term (i.e., several weeks in duration) WBV training on mobility in MS patients.

2. Methods

In this meta-analysis, eligibility criteria, data sources, selection of studies, quality, and subgroup analyses were determined a priori. The principles of Cochrane reviewers' handbook were followed.

2.1. Eligibility criteria

Only clinical WBV RCTs which included only MS patients and the duration of training was several weeks and comprised several training sessions were accepted to this meta-analysis. Single session WBV studies were excluded irrespective of the subsequent follow-up time. The duration of at least several weeks was chosen because we wanted to study the long-term training effects and separate them from apparent acute effects of WBV training. As to the MS diagnosis, we included all forms of the disease. Studies written in English, Finnish or Swedish and published before October 2013 were included in the primary search.

2.2. Data sources and literature search

The primary search of this meta-analysis was conducted from four electronic databases (PubMed, Sport, CINAHL and Cochrane) by a professional librarian in December 2013. The search strategy was designed to find all relevant randomized, controlled WBV intervention trials published between January 2000 and October 2013. In addition, we reviewed manually the reference lists of articles and, if a potentially eligible RCT not included in the primary search was found, the study report was obtained. After the primary data search, the search was updated by one investigator (HS) in August 2015 using the PubMed database.

The following comprehensive combination of keywords was used: whole body vibration, vibration, training, exercise therapy, physical therapy modalities, physical exertion, physical education and training, platform, vibration/therapeutic use and exercise. The keywords were only MeSH-terms. The keywords describing the type of study included randomized controlled trial, controlled clinical trial, NOT animals.

2.3. Data collection process and quality analysis

One investigator (SiK) reviewed independently all the abstracts found in the primary search and sorted them into about twenty categories by the target group. Three investigators (SiK, SaK, HS) together evaluated and selected all potentially relevant full-text articles that dealt with MS patients and provided relevant data on physical performance and/or functioning. SiK reviewed also the reference lists of the selected full-texts and checked that the search covered all relevant studies and no such articles were missing. SaK and HS together selected the appropriate outcome variables to the analysis. Then SiK extracted the data from original full-text articles, and HS rechecked all selected data.

The methodological quality of the included articles was assessed using the Cochrane risk of bias assessment tool. The criteria list contained seven items: random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), incomplete outcome data (attrition bias), blinding of outcome assessment (detection bias), selective outcome reporting (reporting bias), and other potential biases. The risk of bias was judged low if the criteria of high quality were evidently fulfilled; otherwise the risk was considered high or unclear if pertinent information was unclearly expressed or not given. The higher the number of low risk items, the better the quality of the study; proper randomization, allocation concealment and blinding were considered prerequisites for a high quality study. All included studies were independently reviewed by two investigators (SiK, HS). Disagreements were resolved by discussing the paper and seeking consensus, and a third opinion (SaK) was asked if deemed appropriate.

2.4. Data synthesis

For the data synthesis of the meta-analysis, Review Manager 5.2.11 program (Cochrane Collaboration) was used to estimate the pooled effect size from the effects of single RCTs. The meta-analyses were performed on the results from Timed Up and Go test (TUG) [24], Berg Balance Scale (BBS), and walking speed derived from specified walk tests. These outcomes were considered to describe coordination, balance, speed, endurance components of mobility relevant to MS patients [25,26] and were commonly available. The most common outcome was the TUG result.

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