Effects of whole-body vibration exercise on human bone density: systematic review

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CRD summary
Findings suggested that whole-body vibration exercise may be a promising training modality for increasing bone density in the lower half of the body, at least among postmenopausal women. The authors' cautious conclusions reflected the evidence presented, but methodological limitations and the small number of included studies and their small sample sizes made their reliability unclear.

Authors' objectives
To evaluate the effects of whole-body vibration exercise on bone density in humans.

Searching
PubMed, CINAHL, EMBASE, AMED and PEDro databases were searched for articles in English. Search terms were reported. Reference lists from retrieved articles and websites of manufacturers of vibration platforms were searched.

Study selection
Controlled studies that evaluating the effects of whole-body vibration exercise (WBVE) on bone density in humans were eligible for inclusion.

Interventions in the included studies included WBVE alone or together with alendronate, strength training or high intake of protein. Vibration frequencies of WBVE ranged between 12Hz and 90Hz, amplitudes between 0.7mm and 4.2mm and magnitudes between 0.2g and 10g. Accelerations were generally applied in a vertical orientation. Control groups included protein vibration, gait training, alendronate and placebo. Participants' mean age ranged from four years to 88 years. Most studies focused on postmenopausal women with or without osteoporosis. Other participants included young women with reduced bone density and earlier fractures, functional disabilities and healthy subjects. Bone density was measured by urine sample, computed tomography, quantitative computer tomography, dual energy x-ray absorptiometry or 3-D qualitative computer tomography. Duration of interventions ranged from three weeks to 12 months.

The authors did not state how articles were selected for inclusion.

Assessment of study quality
Validity was assessed using the PEDro scale (maximum 11 points). Studies were graded high (8 to 11 points), medium (4 to 7 points) and low (0 to 3 points). A WBVE scale was also used (one point per criteria, maximum of 9 points).

Two reviewers independently assessed validity. Disagreements were resolved through discussion or by a third reviewer.

Data extraction
Data were extracted on differences in bone density between groups.

The authors did not state how many reviewers extracted data.

Methods of synthesis
Data were combined in a narrative synthesis. Studies were graded by the strength of evidence: strong (at least two independent studies with high evidence), moderate (one study with high evidence and two studies with medium evidence), limited (at least two studies with medium evidence) and insufficient (fewer than two studies with medium evidence).

Results of the review
Nine trials (n=383) were included in the review: eight randomised controlled trials and one controlled trial.
ranged from 10 to 70. Evidence was graded as high (one trial), medium (seven trials) and low (one trial) using the PEDro scale. Overall the strength of evidence was considered moderate.

Five trials (including three trials in post menopausal women) reported significant increases in bone density (0.4% to 10.2%) for WBVE at six to 12 months duration in comparison with placebo and weight-bearing regimes. One trial reported a decrease in secretion of calcium phosphate after three weeks WBVE. Three trials (including two trials in post menopausal women) reported no statistically significant differences between groups.

Six trials reported largest bone density increases in trabecular bone of the hip, back or proximal tibia. One trial reported the largest bone density increase in the cortical bone of the tibia.

No serious adverse events were reported. Minor adverse events in the WBVE groups included temporary itching and skin redness in the lower extremities, and knee pain after using WBVE in two overweight subjects (two trials).

Authors’ conclusions
Findings suggested that WBVE may be a promising training modality for increasing bone density in the lower half of the body, at least among postmenopausal women. As the overall strength of evidence was considered moderate, several clinical questions needed to be addressed.

CRD commentary
The review question was broadly defined as were the inclusion criteria. Several relevant sources were searched. Restriction to studies in English meant there was potential for language bias. It appeared that no efforts were made to locate unpublished studies and so there was potential for publication bias. Validity was assessed using appropriate criteria. Appropriate methods were used to reduce reviewer error and bias for assessment of validity; it was unclear whether similar methods were used for study selection and data extraction. A narrative synthesis was appropriate given the differences between studies in terms of intervention and participants.

The authors’ cautious conclusions reflected the evidence presented, but potential for language and publication biases, a lack of reporting of review methods, the small number of included studies and their small sample sizes made their reliability unclear.

Implications of the review for practice and research
Practice: The authors stated that WBVE could be used by people who had difficulty participating in ordinary training regimes that involved many dynamic movements.

Research: The authors stated that further research was required and should compare static and dynamic training regimes and investigate effects on patients with various comorbid conditions.

Funding
Not stated.

Bibliographic details

DOI
10.1179/174328808X356438

Indexing Status
Subject indexing assigned by CRD

MeSH
Aged; Bone Density; Exercise; Female; Humans; Middle Aged; Osteoporosis; Osteoporosis, Postmenopausal; Postmenopause; Vibration /therapeutic use

AccessionNumber
12009104082

Date bibliographic record published
16/12/2009

Date abstract record published
12/01/2011

Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.