Evidence-based Practice Center
Technical Brief
Project Title: Whole-Body Vibration Therapy for Osteoporosis

I. Background and objectives

Osteoporosis is a disease of the skeletal system characterized by low bone mass and deterioration of bone tissue.[1] Osteoporosis is a significant public health problem that leads to increased bone fragility and an increased risk of bone fractures typically in the wrist, hip, and spine.[1] In an epidemiological study conducted in Switzerland, half of all fractures in women and 24 percent in men were considered to be osteoporotic.[2] In the United States, the estimated 1.5-million yearly osteoporotic fractures result in more than 500,000 hospitalizations, 800,000 emergency room visits, 2.6 million physician office visits, and 180,000 nursing home placements.[1] Hip fractures, in particular, have been shown to be associated with an increased risk of death.[1] Fractures can also cause pain, height loss, and functional disability, and individuals that suffer from a fracture are also at risk for other complications, such as pressure sores and pneumonia.[1] Osteoporosis affects 2 percent of men and 10 percent of women over the age of 50 in the U.S.[3] In addition, 49 percent of older women and 30 percent of elderly men in the U.S. have low bone density or osteopenia.[3] By 2020, approximately half of all elderly Americans will be at risk for fractures from osteoporosis or low bone mass.[1]

The U.S. Preventive Services Task Force recommends active screening for osteoporosis and early intervention to prevent bone fractures.[4] Current clinical guidelines recommend dietary and pharmacological interventions to treat osteoporosis and prevent bone fractures.[5-9] An increase of 1 standard deviation in bone mineral density in women would prevent 33 percent of hip fractures and 77 percent of vertebral fractures.[10] Despite proven effectiveness, these treatments may have low rates of long-term adherence. In addition, pharmacological interventions can result in adverse effects, commonly atypical fractures, renal toxicity, and osteonecrosis of the jaw.[11-15] Alternative therapies, including weight-bearing exercise, may also increase bone density[16,17] and are safer than medication. The U.S. Preventive Services Task Force encourages research on new alternative interventions that may have higher adherence rates and lower risks of side effects to help prevent osteoporosis.[18]

One possible intervention is whole-body vibration therapy.[19-23] Whole-body vibration was originally proposed as a means to build bone density for astronauts in space;[24] like other weight-bearing physical activities, it causes muscles and bones to work against gravity.[3] Recently, whole-body vibration has been considered to be a possible therapeutic intervention for increasing bone density in the elderly and others at risk for osteoporosis.[19,25-30]

How vibration therapy increases bone density is not well understood.[31,32] One hypothesis is that vibration signals are transmitted and amplified into bone tissue, directly activating mechanosensors in bone cells.[33] Animal studies demonstrated that vibration increases the anabolic (bone building) activity of bone tissue and increases bone

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density.[24,34-36] Another hypothesis is that the effect of whole-body vibration is similar to other weight-bearing exercise[37,38] and improves muscle strength and power by increasing neuromuscular activation.[39,40] Human studies on healthy volunteers examined adaptive muscle strength and performance after vibration therapy and found that the effects were similar to those achieved with short-term resistance exercise.[37,38] Several studies show that whole-body vibration therapy improves muscle and bone circulation, increasing the supply of nutrients needed to build bones.[20,41-44]

Using vibration therapy to increase bone mass and decrease the risk of fractures has been discussed elsewhere in the literature,[20-23,32,45-48] including recommendations made by the International Society of Musculoskeletal and Neuronal Interactions.[47] To date, a description of the available evidence on vibration therapy for the various populations at risk of or with osteoporosis has never been summarized.

We aim to provide a description of the state of the science and an overview of the key issues related to the use of whole-body vibration therapy to improve bone density and treat osteoporosis, including modalities, standards, relevant patient populations, outcomes measured, and implications for future research. The scope of this report is confined to whole-body vibration platforms designed and marketed for prevention and treatment of osteoporosis. The scope of the report does not include exercise equipment with vibrating platforms intended for use in physical fitness or athletic regimens.

II. Guiding Questions

1. *Describe the Existing Technology.*
   a. What vibration modalities have been proposed or used in practice to treat osteoporosis?
   b. What are the potential advantages and disadvantages of vibration therapy when compared to regular exercise and pharmacological treatments of osteoporosis in preventing osteoporotic fractures?
   c. What are the potential safety issues and harms of vibration therapy when used to treat osteoporosis?
2. *Describe the Context in Which the Technology Is Used.*
   a. What kinds of training, certification, and staffing are required for vibration therapy?
   b. How are treatment sessions in clinical settings billed?
   c. What is the current U.S. Food and Drug Administration (FDA) approval status of vibration therapy for osteoporosis?
   d. What modifications of vibration platforms are in development?
3. *Describe the Current Evidence of the Technology.*
   a. What are the inclusion and exclusion criteria of patients in therapeutic studies of vibration therapy for osteoporosis?
   b. What modalities of vibration therapy for osteoporosis have been examined in therapeutic studies?

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c. What was the length, intensity, and frequency of each vibration therapy session, and what was the total duration of the vibration therapy intervention?
d. What primary and secondary outcomes and harms were examined?
e. What comparators were used to examine benefits and harms?
f. What was the length of followup to examine benefits and harms?
g. What were the methodological approaches or study designs used (i.e., randomized controlled trial, cohort, case control, etc.)?

4. *Identify the Important Issues Raised by the Technology.*
   a. What are the implications of reimbursement practices on accessibility?
   b. What are the possible areas of confusion or potential harms from misuse in direct-to-consumer marketing and unsupervised consumer use?
   c. What medical claims about effectiveness have been made, and how do they compare to what is available in the literature? What are the implications for third-party payers?
   d. What are possible areas of future research?

   Note: These questions may be modified over the course of the research as additional information is uncovered.

III. Methods

We will integrate the information from the key informants and a systematic literature review into a single, cohesive review process. In particular, responses to questions 1, 2, and 4 will rely on information from key informants and published information about vibration technology, the applications of the technology, and the FDA-approval process. Responses to question 3 will be based on peer-reviewed, published studies that examined outcomes after whole-body vibration for osteoporosis.

1. Data Collection.

A. Discussion With Key Informants.

We will identify relevant key informants for this technical brief, ensuring both balanced viewpoints and efficient data collection. We will include experts on whole-body vibration therapy and in the treatment of osteoporosis, and clinicians who use whole-body vibration therapy in their practices. We will also include public purchasers of healthcare, consumer advocates, and potential consumers. Representatives from device manufacturers will only be included as key informants if two or more firms with leading research and development staff have representatives available to provide a balanced view from competing perspectives. We will locate potential key informants from frequently listed and cited authors of relevant literature, Internet searches for possible candidates of relevant viewpoints, and nominations by other key informants. In cases where the Evidence-based Practice Center (EPC) staff is not able to identify a specific individual to represent a specific organization, we will invite the organization to nominate an individual. In cases where a key informant

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has a potential conflict of interest but is still deemed to have a viewpoint or specific expertise critical to the technical brief, we will interview them separately from other key informants to avoid undue influence.

We will conduct semistructured interviews with the key informants to gather information on their opinions regarding whole-body vibration therapy for improved bone health. Listed below are examples of the types of questions that will be used in the key informant discussions. The key informants will receive invitation letters that will provide a brief description of the project and the key informant's expected role, and appropriate disclosure forms for conflicts of interest. Experts in the field will be convened by a group conference call. Clinicians and advocates may also be separately convened by a group conference call. Consumers will be interviewed separately. Summaries of calls will be circulated to participants for content confirmation.

Questions for Third-Party Payers.

a. What information about whole-body vibration is most needed by payers?
b. What criteria (clinical effectiveness, safety, FDA approval, market value, others) are the most critical when making payment coverage decisions for whole-body vibration?
c. What kinds of research would be most useful to make evidence-based coverage decisions?
d. What outcomes do payers take into consideration for coverage decisions?

Questions for Osteoporosis Content Experts.

a. What are the criteria used to determine appropriate patient populations for whole-body vibration therapy?
b. What are the potential advantages and disadvantages of vibration therapy when compared to regular exercise and pharmacological treatments of osteoporosis in preventing osteoporotic fractures?
c. What modifications of vibration platforms are available in the U.S.? What modifications of vibration platforms are in development?
d. What is the current FDA-approval status of vibration therapy for adults with osteoporosis?
e. What kinds of training, certification, and staffing are required for vibration therapy?
f. What type of research is needed most? What research designs are most likely to answer the important research questions?
g. What outcomes are appropriate measures of the efficacy and effectiveness of vibration therapy?
h. When should patient outcomes be measured (length of followup)?

Questions for Clinicians, Patients, and Patient Advocates.

a. What has been your experience with whole-body vibration therapy?

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b. What information do clinicians and patients need to know to make informed decisions about whole-body vibration (effectiveness, safety, FDA approval, doctor recommendation, other)?
c. What information do clinicians and patients need to know when to use alternative therapeutic options for osteoporosis?
d. What is the measurement of successful treatment for osteopenia and osteoporosis?

B. Grey Literature Search.

We will conduct a grey literature search of Federal Government Web sites (e.g., www.medicare.gov) for current coverage and/or payment policies, the FDA Web site for approval reviews, and presentations of unpublished studies at scientific meetings. We will also search the Internet with different engines (e.g., Google Scholar, Scirus, LexisNexis) to obtain, for example, information on availability and other issues and controversies regarding vibration platforms. We will survey enrolling and ongoing clinical trials though ClinicalTrials.gov. We will search the CSA Physical Education Index, the Web of Science®, and Medscape® databases to find studies that were presented in scientific meetings. We may also try to obtain coverage information for some major private insurers.

C. Published Literature Search.

We will search for relevant articles on the use of whole-body vibration to treat patients with low bone density. We will include studies published in English of any sample size, any design (randomized controlled trial, controlled clinical trial, uncontrolled observational trial, and case reports and series) and studies that report any clinical outcome (e.g., bone density, bone mineral content, bone fractures).

We will search several databases: MEDLINE® via OVID and via PubMed®, the Cochrane Library, AMED, CINAHL, the CSA Physical Education Index, the Web of Science, PEDro, and Academic Search™ Premier. Exact search strategies have been developed in consultation with the EPC librarian and guided by the Scientific Resource Center. We have developed an a priori search strategy based on relevant medical subject headings (MeSH) terms, text words, and a weighted word-frequency algorithm to identify related articles. The key informants may suggest additional sources for evidence.

For question 3, we will screen the abstracts against the following inclusion and exclusion criteria:

1. Healthy adults and children.
2. Market evaluations of whole-body vibration platforms.

We will retrieve and review full articles on eligible studies to determine final inclusion. We will repeat the literature search to identify literature published up to

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February 2011 and to determine whether the new material provides additional information not previously covered in the report.

2. Data Organization and Presentation.

A. Information Management.

Data from the published literature will be abstracted by using the standardized data-abstraction tool shown in Appendix 2. One reviewer will collect the data and assess the evidence against the inclusion and exclusion criteria. We will not abstract actual results from the studies.

Data from the published literature will be integrated with information from the grey literature and key informant discussions. Responses to questions 1 and 2 will be formed with information from published narrative reviews, information in the grey literature, and key informant discussions. Responses to question 3 will be based primarily on peer-reviewed, published literature and may be combined with some information gleaned from the grey literature (e.g. information from ongoing studies). Responses to question 4 will be informed by discussions with key informants along with information regarding the technology and the context within which it is used, and the existing research gathered to address questions 1–3.

B. Data Presentation.

The data will be presented in narrative form (Q1, 2, and 4) and in evidence tables. We will summarize the evidence into summary tables/plots by population subgroup, vibration platform, study location, size and design, and examined outcomes.

Proposed templates for summary tables.

Table 1. List of vibration therapy platforms that are available for home-based exercise and for exercise in clinical settings

Vibration platform (brand and type)	Manufacturer	Status (fitness vs. medical device)	Characteristics of the device	Number of studies that tested the platform (references)

Table 2. Distribution of the studies that examined the effects of vibration therapy by study design, sample size, characteristics of intervention (dose, amplitude, frequency, duration), and comparators

Vibration platform	Vibration amplitude	Vibration duration	Study design	Sample size	Comparator

Table 3. Distribution of the studies that examined vibration therapy in different populations

Vibration platform	Country	Inclusion criteria-age, comorbidities	Exclusion criteria	Inclusion of men	Inclusion of minorities	Concomitant treatment for osteoporosis

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Table 4. Distribution of the studies that examined different outcomes after vibration therapy

Vibration platform	Fracture (N RCTs/other studies)	BMD (N RCTs/other studies)	BMC (N RCTs/other studies)	Harms (N RCTs/other studies)	Quality of life	Other outcomes

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IV. References

1. US Department of Health and Human Services. *Bone Health and Osteoporosis: A Report of the Surgeon General*. Rockville, MD: US Department of Health and Human Services; 2004.

2. Lippuner K, Golder M, Greiner R. Epidemiology and direct medical costs of osteoporotic fractures in men and women in Switzerland. *Osteoporos Int* 2005;16(Suppl 2):S8-17.

3. Looker AC, Melton LJ 3rd, Harris TB, et al. Prevalence and trends in low femur bone density among older US adults: NHANES 2005–2006 compared with NHANES III. *J Bone Min Res* 2010;25:64-71.

4. Belavy DL, Miokovic T, Armbrecht G, et al. Resistive vibration exercise reduces lower limb muscle atrophy during 56-day bed-rest. *J Musculoskelet Neuronal Interact* 2009;9:225-35.

5. Compston J, Cooper A, Cooper C, et al. Guidelines for the diagnosis and management of osteoporosis in postmenopausal women and men from the age of 50 years in the UK. *Maturitas* 2009;62:105-8.

6. Qaseem A, Snow V, Shekelle P, et al. Pharmacologic treatment of low bone density or osteoporosis to prevent fractures: a clinical practice guideline from the American College of Physicians. *Ann Intern Med* 2008;149:404-15.

7. Watts NB, Lewiecki EM, Miller PD, et al. National Osteoporosis Foundation 2008 Clinician's Guide to Prevention and Treatment of Osteoporosis and the World Health Organization Fracture Risk Assessment Tool (FRAX): what they mean to the bone densitometrist and bone technologist. *J Clin Densitom* 2008;11:473-7.

8. Kanis JA, Burlet N, Cooper C, et al. European guidance for the diagnosis and management of osteoporosis in postmenopausal women. *Osteoporos Int* 2008;19:399-428.

9. Hamdy RC, Baim S, Broy SB, et al. Algorithm for the management of osteoporosis. *South Med J* 2010;103:1009-15..

10. LaFleur J, McAdam-Marx C, Kirkness C, et al. Clinical risk factors for fracture in postmenopausal osteoporotic women: a review of the recent literature. *Ann Pharmacother* 2008;42:375-86.

11. Shane E, Burr D, Ebeling PR, et al. Atypical subtrochanteric and diaphyseal femoral fractures: report of a task force of the American Society for Bone and Mineral Research. *J Bone Min Res* 2010;25:2267-94.

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12. van Duijnhoven NTL, Thijssen DHJ, Green DJ, et al. Resistive exercise versus resistive vibration exercise to counteract vascular adaptations to bed rest. J Appl Physiol 2010;108:28-33.

13. Bruyere O, Burlet N, Delmas PD, et al. Evaluation of symptomatic slow-acting drugs in osteoarthritis using the GRADE system. *BMC Musculoskelet Disord* 2008; 9:165.

14. Taggart H, Bolognese MA, Lindsay R, et al. Upper gastrointestinal tract safety of risedronate: a pooled analysis of 9 clinical trials. *Mayo Clin Proc* 2002;77:262-70.

15. Kim SY, Kim MJ, Cadarette SM, et al. Bisphosphonates and risk of atrial fibrillation: a meta-analysis. *Arthritis Res Ther* 2010;12:R30. Epub 2010 Feb 19.

16. Lewis RD, Modlesky CM. Nutrition, physical activity, and bone health in women. *Int J Sport Nutr* 1998;8:250-84.

17. Rizzoli R, Bianchi ML, Garabedian M, et al. Maximizing bone mineral mass gain during growth for the prevention of fractures in the adolescents and the elderly. *Bone* 2010;46:294-305.

18. Lim LS, Hoeksema LJ, Sherin K. Screening for osteoporosis in the adult US population: ACPM position statement on preventive practice. *Am J Prev Med* 2009;36:366-75.

19. Gusi N, Raimundo A, Leal A. Low-frequency vibratory exercise reduces the risk of bone fracture more than walking: a randomized controlled trial. *BMC Musculoskelet Disord* 2006;7:92.

20. Cardinale M, Pope MH. The effects of whole body vibration on humans: dangerous or advantageous? *Acta Physiol Hung* 2003;90:195-206.

21. Cardinale M, Rittweger J. Vibration exercise makes your muscles and bones stronger: fact or fiction? *J Br Menopause Soc* 2006;12:12-8.

22. Cardinale M, Wakeling J. Whole body vibration exercise: are vibrations good for you? *Br J Sports Med* 2005;39:585-9.

23. Eisman JA. Good, good, good... good vibrations: the best option for better bones? *Lancet* 2001;358:1924-5.

24. Rubin C, Xu G, Judex S. The anabolic activity of bone tissue, suppressed by disuse, is normalized by brief exposure to extremely low-magnitude mechanical stimuli. *FASEB J* 2001;15:2225-9.

25. von Stengel S, Kemmler W, Engelke K, et al. Effects of whole body vibration on bone mineral density and falls: results of the randomized controlled ELVIS study with postmenopausal women. *Osteoporos Int* 2010 Mar 20.

26. Slatkovska L, Alibhai SM, Beyene J, et al. Effect of whole-body vibration on BMD: a systematic review and meta-analysis. *Osteoporos Int* 2010 Apr 21. DOI: 10.1007/s00198-010-1215-4.

27. Torvinen S, Kannus P, Sievanen H, et al. Effect of 8-month vertical whole body vibration on bone, muscle performance, and body balance: a randomized controlled study. *J Bone Min Res* 2003;18:876-84.

28. Rubin C, Recker R, Cullen D, et al. Prevention of postmenopausal bone loss by a low-magnitude, high-frequency mechanical stimuli: a clinical trial assessing compliance, efficacy, and safety. *J Bone Min Res* 2004;19:343-51.

29. Iwamoto J, Takeda T, Sato Y, et al. Effect of whole-body vibration exercise on lumbar bone mineral density, bone turnover, and chronic back pain in post-menopausal osteoporotic women treated with alendronate. *Aging Clin Exp Res* 2005;17:157-63.

30. Verschueren SMP, Roelants M, Delecluse C, et al. Effect of 6-month whole body vibration training on hip density, muscle strength, and postural control in postmenopausal women: a randomized controlled pilot study. *J Bone Min Res* 2004;19:352-9.

31. Flinn ED. Subtle shake-up in bone-loss research. *Aerospace America* 2002;40:16-8.

32. Rittweger J. Vibration as an exercise modality: how it may work, and what its potential might be. *Eur J Appl Physiol* 2010;108:877-904.

33. Rubin C, Pope M, Fritton JC, et al. Transmissibility of 15-hertz to 35-hertz vibrations to the human hip and lumbar spine: determining the physiologic feasibility of delivering low-level anabolic mechanical stimuli to skeletal regions at greatest risk of fracture because of osteoporosis. *Spine (Phila Pa 1976)* 2003;28:2621-7.

34. Xie L, Jacobson JM, Choi ES, et al. Low-level mechanical vibrations can influence bone resorption and bone formation in the growing skeleton. *Bone* 2006;39:1059-66.

35. Judex S, Lei X, Han D, et al. Low-magnitude mechanical signals that stimulate bone formation in the ovariectomized rat are dependent on the applied frequency but not on the strain magnitude. *J Biomech* 2007;40:1333-9.

36. Xie L, Rubin C, Judex S. Enhancement of the adolescent murine musculoskeletal system using low-level mechanical vibrations. *J Appl Physiol* 2008;104:1056-62.

37. Bosco C, Iacovelli M, Tsarpela O, et al. Hormonal responses to whole-body vibration in men. *Eur J Appl Physiol* 2000;81:449-54.

38. Erskine J, Smillie I, Leiper J, et al. Neuromuscular and hormonal responses to a single session of whole body vibration exercise in healthy young men. *Clin Physiol Funct Imaging* 2007;27:242-8.

39. Fritton JC, Rubin CT, Qin YX, et al. Whole-body vibration in the skeleton: development of a resonance-based testing device. *Ann Biomed Eng* 1997;25:831-9.

40. Gilsanz V, Wren TAL, Sanchez M, et al. Low-level, high-frequency mechanical signals enhance musculoskeletal development of young women with low BMD. *J Bone Min Res* 2006;21:1464-74.

41. Russo CR, Lauretani F, Bandinelli S, et al. High-frequency vibration training increases muscle power in postmenopausal women. *Arch Phys Med Rehabil* 2003;84:1854-7.

42. Torvinen S, Kannu P, Sievanen H, et al. Effect of a vibration exposure on muscular performance and body balance. Randomized cross-over study. *Clin Physiol Funct Imaging* 2002;22:145-52.

43. Ward K, Alsop C, Caulton J, et al. Low magnitude mechanical loading is osteogenic in children with disabling conditions. *J Bone Min Res* 2004;19:360-9.

44. Tanaka SM, Alam IM, Turner CH. Stochastic resonance in osteogenic response to mechanical loading. *FASEB J* 2003;17:313-4.

45. Nokes LD, Thorne GC. Vibrations in orthopedics. *Crit Rev Biomed Eng* 1988; 15:309-49.

46. Prisby RD, Lafage-Proust M-H, Malaval L, et al. Effects of whole body vibration on the skeleton and other organ systems in man and animal models: what we know and what we need to know. *Ageing Res Rev* 2008;7:319-29.

47. Rauch F. Vibration therapy. *Dev Med Child Neurol* 2009;51(Suppl 4):166-8.

48. Totosy de Zepetnek JO, Giangregorio LM, Craven BC. Whole-body vibration as potential intervention for people with low bone mineral density and osteoporosis: a review. *J Rehabil Res Dev* 2009;46:529-42.

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V. Definition of Terms

Bone density:

The amount of mineral (calcium phosphate) per square centimeter of bone. Bone mineral density values are calculated by using reference values for healthy young white women who are 20 to 29 years of age and are expressed in standard deviation (SD) units and reported as a T-score:

Normal bone density:	T-score >1 SD
Osteopenia:	T-score between-1 and -2.5
Osteoporosis:	T-score <2.5 SD
Osteoporosis:	reduction of bone mass without alteration in the composition of bone, leading to increased risk of fractures

Therapeutic vibration:

Use of a continuing periodic change in displacement of the body or parts of the body with respect to a fixed reference point of the body position.

The intensity of whole-body vibration exercise:

The frequency of oscillations per second (Hz/sec), or the amplitude of the vibration platform (displacement of the platform from a horizontal position in mm).

Vibration acceleration:

The function of the frequency and amplitude ([meter/second]/second)

VI. Summary of Protocol Amendments

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Appendix 1.

Preliminary literature search. We searched the MEDLINE, Cochrane Library, CINAHL, CSA Physical Education Index Web of Science, PEDro, and Academic Search Premier databases using the key words "whole body vibration," "vibration," and "osteoporosis."

Software: Ovid Technologies, Inc. Email Service

Search for: 18 not 19

Results: 120

Database: Ovid MEDLINE(R) <1950 to August Week 4 2010>

Search Strategy:

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1 exp Vibration/tu [Therapeutic Use] (511)
2 whole body.mp. (39402)
3 1 and 2 (71)
4 exp Muscle Strength/ (10075)
5 exp "Recovery of Function"/ (19156)
6 4 or 5 (28640)
7 1 and 6 (27)
8 3 or 7 (85)
9 wbv.mp. (309)
10 1 and 9 (36)
11 8 or 10 (85)
12 exp Muscle, Skeletal/ (165830)
13 1 and 12 (65)
14 11 or 13 (114)
15 exp Physical Therapy Modalities/ (99436)
16 1 and 15 (206)
17 14 or 16 (278)
18 limit 17 to (english language and humans and yr="2000 -Current") (127)
19 limit 18 to (case reports or editorial) (7)
20 18 not 19 (120)
21 exp Osteoporosis/rh, th [Rehabilitation, Therapy] (2609)
22 1 and 21 (14)

PubMed search strings #

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Search "Vibration/therapeutic use"[MAJR] Limits: Humans, Randomized Controlled Trial, English	68
Search "Vibration/therapeutic use"[MAJR] Limits: Humans, Journal Article, English	1287
Search "Vibration"[Mesh] Limits: Humans, Journal Article, English	6541
Search vibration AND osteoporosis Limits: Humans, Journal Article, English	71
Search vibration AND osteoporosis	119

Cochrane Library: Whole body vibration for preventing and treating osteoporosis (Protocol)

CINAHL: 212 references

Appendix 2.

Abstraction form.

Publication Information

Author

Title

Year of publication

Journal

Research Design

Type of study design

P — Patient Population

Country of residence of patients

Inclusion criteria

Exclusion criteria

Number of patients in treatment group

Presence of men in treatment group (yes or no)

Presence of minorities in treatment group (yes or no)

Patients with comorbidities in treatment group (yes or no)

Patients with prior treatments for osteoporosis in treatment group (yes or no)

Patients receiving other treatments for osteoporosis in addition to vibration therapy during study (yes or no)

Patients receive vibration therapy in combination with other exercise (yes or no)

I — Intervention Characteristics

Therapy done in home or clinical setting

Type of vibration therapy

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Manufacturer of vibration platform
Vibration platform frequency
Vibration platform magnitude
Vibration platform amplitude
Length of each vibration session
Pattern of vibration session
Frequency of vibration sessions
Total time of vibration therapy intervention
Compliance with intervention measured
Length of follow-up

C — Comparison Group

Number of participants in comparison group

O — Outcomes

Bone mass density as outcome of interest (yes or no)
Measures used to assess bone mass density
Site of bone mass density measurement
Bone mineral content as outcome of interest (yes or no)
Measures used to assess bone mineral content
Fracture as outcome of interest (yes or no)
Measures used to assess fracture
Quality of life as outcome of interest (yes or no)
Measures used to assess quality of life
Harms reported for treatment group
Other outcomes

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