Effect of weighted exercises on bone mineral density in post menopausal women: a systematic review
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CRD summary
The review concluded that weighted exercises can be beneficial in maintaining bone mineral density (BMD) in postmenopausal women, and in increasing BMD of the spine and hip in women with osteopenia and osteoporosis. However, the poor reporting of the review methods and analysis, and the apparent differences between the studies, suggest that the findings may not be reliable.

Authors' objectives
To determine the effectiveness of weighted exercise programs in maintaining or increasing bone mineral density (BMD) in postmenopausal women at risk of or with osteoporosis.

Searching
MEDLINE, CINAHL, EMBASE, PEDro and the Science Citation Index were searched for studies reported in English from 1990 to February 2005; the search terms were reported.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) and non-randomised trials with more than 15 participants were included.

Specific interventions included in the review
Studies of weighted or resistive exercises as a therapy to promote osteogenesis were eligible for inclusion. The studies included a range of exercise programmes with varying degrees of training intensity and frequency (details reported in the review). The duration of exercise ranged from 4 to 60 months.

Participants included in the review
Studies of postmenopausal women aged between 40 and 80 years old were eligible for inclusion. Studies were excluded if they included women with any orthopaedic problem (including a BMD result of -3 standard deviations or below and a history of an osteoporotic fracture) or cardiovascular problem that would limit exercise, or took any medication known to alter bone metabolism except oestrogen. The participants included in the review were aged from 40 to 75 years (where stated). A number of studies included women on hormone replacement therapy (HRT).

Outcomes assessed in the review
Studies that assessed change in BMD using a dual-energy X-ray absorptiometry (DXA) scan were eligible for inclusion. Commonly reported sites of DXA scans used in the reported studies included lumbar spine, femoral neck and trochanter.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, although they reported that an expert on the topic reviewed the list of included studies for omissions.

Assessment of study quality
Validity was assessed using MacDermid guidelines, which quality rated 24 measures for each study. Each measure could be scored from 0 to 2 (highest score), thus the maximum score possible was 48 points. The authors did not state how the validity assessment was performed.

Data extraction
The authors did not state how the data were extracted for the review.
Methods of synthesis
How were the studies combined?
The studies were combined in a narrative. Each study was described in the text, with additional descriptive information presented in the tables.

How were differences between studies investigated?
Some differences between the studies were evident from the data tables, while others were described in the text of the review.

Results of the review
The authors reported that 20 studies were included, though 21 studies appear to have been included in the analysis (n=1,626 approximately).

Two studies scored less than 30 on the validity scale, 14 studies scored between 30 and 40, and 5 studies scored between 40 and 45 points.

Evidence of an increase in BMD was found in 7 studies. A positive outcome was found for bone maintenance in the exercise group compared with a decline in BMD in the control groups (6 studies). Ground reaction forces and joint reaction forces resulted in increases in BMD (1 study), and sites exposed to both improved more than sites stressed by only ground reaction forces (3 studies). A study that allowed HRT and separated users into groups found that the groups using a combination of HRT and exercise produced greater increases in BMD in the exercise group than in the control group. No difference in BMD was found between the exercise group and control group in 3 studies.

Studies with a positive outcome, or that showed an increase in BMD, were over 11 months in duration (9 studies). Interventions lasting 4 to 8 months resulted in less bone loss in the exercise group than in the control group (4 studies). There was an increase in lumbar BMD for a weighted exercise programme lasting 9 months (1 study).

In studies with positive results (11 studies), training intensity was 70 to 90% of 1 RM (maximal load for one repetition with good form) for two to three sets of 8 to 12 repetitions. For these studies, training sessions were performed 3 to 5 times a week and lasted from 45 to 70 minutes each session (8 studies). There was an increase in BMD when weights equalling 80% of maximal back extensor strength were used (1 study).

A site-specific positive effect of exercise on BMD was found in the femoral trochanter (6 studies), and an increase or maintenance in BMD reported at the femoral neck (5 studies). A positive exercise effect was reported at Ward’s triangle (3 studies) and on BMD in the lumbar spine (4 studies). A positive exercise effect on the wrist (ultradistal radial site) was reported in only 1 study.

Authors’ conclusions
Weighted exercises can be beneficial in maintaining BMD in postmenopausal women and in increasing BMD of the spine and hip in women with osteopenia and osteoporosis. Given the chronic nature of bone loss in older women, the exercise programme must be incorporated into a lifestyle change and be lifelong.

CRD commentary
There was a clearly stated review question. Several relevant sources were searched. No attempts were made to locate unpublished studies and, together with the restriction to English language studies, this might have resulted in relevant studies being missed. The review methods were not described, thus it is difficult to assess the risk of reviewer error and bias. Validity was assessed using an established checklist but only the composite score was presented; this makes it difficult for the reader to judge the validity of the studies for themselves. Characteristics of the included studies were tabulated. However, the results for individual studies were reported without supporting data or levels of statistical significance, which means it is not possible to verify the findings reported in the review. The authors identified the diversity of the participants as a limitation of the review. There was also variation between the studies in terms of the intervention and potential confounding through the inclusion of HRT in some studies. In addition, the authors did not report individual study designs or differentiate between randomised and non-randomised studies in the analysis. In
summary, the poor reporting of the review methods and analysis, and the apparent differences between studies, suggest that the findings may not be reliable.

**Implications of the review for practice and research**

**Practice:** The authors stated that physical therapists should revise their usual treatment for postmenopausal women with osteopenia or at risk of osteoporosis in the light of the results of this review.

**Research:** The authors stated that further RCTs are needed to determine the long-term effects of weighted exercise on BMD in postmenopausal women, particularly in relation to effects on the spine and wrist. Future studies should be free of confounding variables such as HRT and other medications that may affect BMD. In addition, groups of participants should not mix early postmenopausal women with elderly women.

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