

WOMEN'S HEALTH: THE BEST STRENGTH TRAINING PROGRAM FOR OSTEOPOROSIS PREVENTION

BY LAUVE METCALFE, M.S., FAWHP

Women achieve peak bone mass in their 20s, and then begin to lose bone with the process accelerating at the onset of menopause. While most will not experience a hip or vertebrae fracture, many may develop low bone mineral density and be at risk for osteopenia or osteoporosis before the onset of menopause. Establishing an exercise program for adult women that addresses osteoporosis can slow down bone loss and reduce the loss of muscle mass over time.

Osteoporosis is a significant health problem in the United States. More than 25 million people are affected, most of whom (80%) are women. Women who are not receiving hormone replacement therapy, are not consuming adequate amounts of calcium, and are inactive can lose 20% to 30% of their peak bone mass between 40 and 70 years of age. As a result, women have a 40% fracture risk throughout their lifetime, with more than 1.5 million fractures per year attributed to osteoporosis.³ According to the U.S. National Women's Health Resource Center, 59% of women over age 40 have not talked with their physician about bone health or have had a bone mineral density scan.

THE BEST STRENGTH TRAINING PROGRAM

With this important public health issue, is it possible to develop an exercise program for sedentary postmenopausal women that could improve bone health and prevent osteoporosis? Would these same women engage in a vigorous strength training program three times a week for a year? Would this program make a significant difference beyond bone health in their lives?

These were the fundamental questions that a research team at the University of Arizona considered in the development of the Bone, Estrogen, and Strength Training (BEST) study. The BEST study began in 1995 to examine how strength-training exercise affects changes in bone density in two groups of postmenopausal women: those on hormone therapy and those who were not.

BEST STUDY OBJECTIVES

Many of the recommendations to prevent bone loss encourage weight bearing exercises such as walking, but the value of strength training is often overlooked. Previous research focusing on strength training with postmenopausal women found that bone mass can be significantly increased by a regimen that uses high load, low repetition (6-8 reps) versus low-load, high-repetition (20 reps) resistance exercises.⁴ The BEST exercise program's main objective was to explore a high-load, low repetition approach in strength training. Considerations underlying the development of the BEST exercise program were to:

- promote exercise at an intensity sufficient to elicit an increase in bone mineral density (BMD) in the hip and lumbar spine
- select exercises specifically designed for function and mobility
- counter the changes in the curvature of the spine and posture of the body that occur with aging (*i.e.*, lordosis)
- develop the small muscle groups of the back that are used for stability, spinal support and posture
- exclude exercises that are counterproductive to maintaining a healthy posture and that put participants at risk for fracture (for example the chest press which pulls the shoulders forward).

During the first year, 266 Tucson, Arizona-area women ranging in age from 45 to 65, who were 3 to 10 years postmenopausal, were recruited. The participants were, sedentary, non-smokers, with no history of bone fractures or osteoporosis. All participants took Citracal[®] calcium citrate supplements twice daily to provide a total 800 mg of calcium. Women were randomized to either an exercise group or a non-exercise control group. Of the 177 women randomized to exercise who underwent baseline measurements, 142 completed the one-year study period (80% retention).

Participants randomized to the exercise intervention were asked to attend training sessions three days per week, on non-consecutive days, in one of four community facilities under the supervision of study on-site trainers. Sessions lasted 60 minutes and included stretching, balance, weight-bearing activities (steps with weighted vests for warm-up or treadmill walking using weighted vests), and weightlifting. Exercise frequency, weightlifting loads, sets and repetitions, steps with weighted vests, and minutes of aerobic activity were recorded in exercise logs that were monitored regularly by on-site trainers.

The participant-to-trainer ratio was five-to-one in the first year. Supervision was reduced during the second year; and in the third and fourth years, trainers were available at each facility once per week. After the fourth year participants were exercising on their own or in small self-selected groups and trainer visits were scheduled bi-monthly.

Weightlifting was done using free weights and machines. Six core exercises focused on major muscle groups with attachments on or near BMD measurement sites. These exercises included the seated leg press, lat (latissimus dorsi) pull down, seated row, back extension, one-arm military press (right and left), and squats (wall squats initially, progressing to Smith or hack squats).

Core BEST strength exercises:

- seated leg press
- seated row
- back extension
- lat pulldown
- one-arm military press
- wall squat, progressing to the Smith squat

Women completed two sets of six to eight repetitions (four to six repetitions for the military press to decrease injury to the shoulder) at 70% (two days per week) or 80% (one day per week) of the one-rep-

etition maximum (1- RM), determined by monthly testing. Repetition maximums were recomputed every six-weeks to adjust loads and offer an opportunity to set goals for the next training period. A detailed description of the exercise program can be found elsewhere.⁶

WHAT BEST RESEARCHERS FOUND

After 12 months, strength training exercises combined with calcium supplementation, significantly improved bone mineral density at skeletal sites at risk for osteoporotic fractures in postmenopausal women.³ Women taking hormone therapy were most successful at maintaining or increasing BMD, although exercise without hormone therapy also showed positive results.

Four-year data showed that women who supplemented with 800mg of calcium daily showed greater improvement than those who consumed less calcium. Participants with higher attendance showed greater improvement than less frequent exercisers, suggesting a dose-response relationship. Those exercisers that attended more exercise sessions and lifted more weight were those that increased their BMD the most, from 1 to 2%.²

Muscle strength improved by 28% to 67% from baseline in women who exercised and used hormone replacement therapy and 25% to 75% in women who exercised without using hormone replacement therapy (see Table). Increases in muscle strength with exercise were statistically significant for exercisers in both groups.

Table. Changes in Muscle Strength Assessed by 1-Rm in Exercise Groups

	Ex/HRT (n=71)			Ex/No HRT (n=71)		
	Baseline*	12 Months*	% Δ	Baseline*	12 Months*	% Δ
Leg Press	260±70	420±103	67	259±64	428±98	75
Lat Pulldown	95±18	121±18	30	98±15	122±17	26
Seated Row	80±12	101±17	28	79±11	99±15	25
One Arm Mil. Press	20±4	27±5	39	20±4	27±5	34
Back Extension	119±27	170±35	47	127±28	168±33	36

*pounds lifted

We also compared women who were lifting weights consistently over four years with those who were less consistent. We divided the BEST women into three groups based on their overall weight lifted using the military press as a measure of exercise compliance (see Figures 1 and 2). We found for both femur trochanter and lumbar spine that those who lifted more weight over four years had significantly greater change in bone mineral density.⁴

Six-year data supported the use of regular strength training as a viable long-term method to prevent weight gain. In fact, an average of training just one to two days per week for six years was enough to maintain body weight in comparison to weight gain seen among controls.¹

INTERVENTION SUPPORT PROGRAMS

The BEST intervention support program was based on social cognitive/social ecological theory constructs and encompassed a variety of interpersonal, intrapersonal, and environmental reinforcement strategies to motivate participants and promote high levels of retention.

Figure 1: Tertiles of Weight lifted in the Military Press

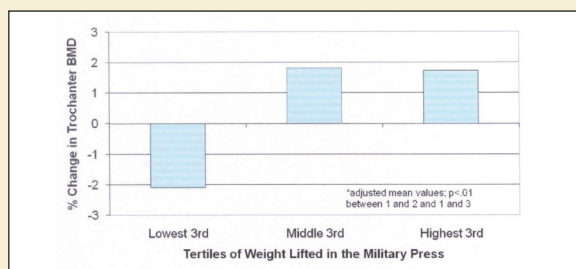
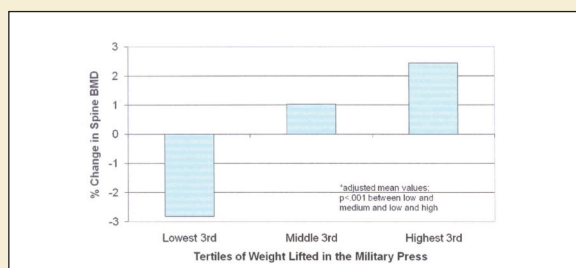


Figure 2: Tertiles of Weight Lifted in Military Press



Goals of the support programs were to create a fun, social environment and to challenge participants to improve daily exercise performance. Participation was based on individual improvement rather than competition among participants. Some examples of the intervention support programs included: orientation workshops, monthly newsletters, Personal Best testing every two months to monitor progress, yearly evaluation results, goal setting logs, personal contracts, motivational meals scheduled every two months, and two major promotional events each year held in January/February and over the summer months at the exercise facilities or at community parks.

The investigators observed strong social benefits related to participating in the exercise program over time. Anecdotal testimonies from the BEST women conveyed the value of the program as a "confidence builder" for life, not just related to their concern of osteoporosis. The participants who have continued with the program and are well into their tenth year of exercise, and are 70+ years of age state that they are emotionally and mentally more resilient to handle whatever life circumstance comes their way. They also have created a remarkable bond with one another and unanimously feel that their exercise program has enriched their lives and given them back their vitality.

CONCLUSIONS

BEST researchers concluded that the participants who maintained bone density with greater effects were those who lifted weights two or more times per week. Over the four years we found that calcium intake, exercise, and hormone therapy all affected BMD change.

The BEST program was designed as an osteoporosis prevention program, not a program for women with osteoporosis. It is recommended to have the supervision of a trainer who is well versed in the principles of safely exercising with high loads and low repetitions to introduce a

participant to the program. It is critical that the exerciser maintain correct form and alignment. Progression and alignment are the safe ways to lift heavier loads with minimal injury for this population.

Given the social and medical impact of osteoporosis, program directors may want to consider development of intervention programs similar to BEST. Such a program is realistic and may be successful in reducing the impact of osteoporosis on public health. The best treatment is prevention, and women of all ages should be concerned about their bone health and take action to stay active and improve their nutrition and bone strength.

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