“Too Fit to Fracture” Guidelines for Skeletal Health and Aging

UCSF 14th Annual Osteoporosis Update

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Disclosures

UCSF license Stand Tall™ exercise program and DVD

◆ Thanks to Dr. Lora Giangregorio and Osteoporosis Canada
Learning objectives

- Review the best evidence for exercise and physical activity in maintenance of skeletal health
- Learn the guidelines for physical activity essential to healthy aging
- Recognize how these guidelines change for skeletal health, and the prevention and treatment of osteoporosis and osteoporotic fractures (“Too Fit to Fracture” guidelines)

Exercise for preventing and treating osteoporosis in postmenopausal women
Pooled results from randomized controlled trials

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Participants</th>
<th>Quality</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of fractures</td>
<td>539 (4 studies)</td>
<td>high</td>
<td>4% absolute difference, but not statistically significant</td>
</tr>
<tr>
<td>Bone mineral density % change: spine</td>
<td>1441 (24 studies)</td>
<td>high</td>
<td>Significant difference between groups +0.85%</td>
</tr>
<tr>
<td>Bone mineral density % change: femoral neck</td>
<td>1338 (19 studies)</td>
<td>low</td>
<td>No significant difference between groups</td>
</tr>
</tbody>
</table>

Howe et al, 2012 Cochrane Database Syst Rev
Effect of Exercise on Bone Density
in Postmenopausal Women
Howe et al, 2012 Cochrane Database Sys Rev

<table>
<thead>
<tr>
<th>Effect of exercise may vary by activity</th>
<th>Hip</th>
<th>Lumbar</th>
</tr>
</thead>
<tbody>
<tr>
<td>General (all studies pooled)</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>High force dynamic (running, jumping)</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Low force dynamic (walking)</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Progressive resistance</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Resistance (low weights)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Combination: High impact/Progressive resistance</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Regular Physical Activity May Reduce Fracture in Older Adults

**Lower risk of hip fracture with:**

- Increased standing
- Regular walking
- Brisk walking pace

The Nurse’s Health Study, 60,000 post-menopausal women followed for 12 years  
Feskanich D, 2002
Regular Physical Activity May Reduce Fracture in Older Adults

**Activity and lowered risk:**
- Standing 10 or more hours/week reduced risk more than 30%
- 4 hours/week walking reduced risk 41%
- 8 hours/week walking reduced risk 55%
- Fast pace reduced risk 65% more than slow

Regular Physical Activity May Reduce Fracture in Older Adults

Moderate to vigorous activity reduced incidence of hip fracture 45 percent among older adults.

Meta-analysis of 13 prospective cohort studies. Potential increased risk for the least and most active.

Moayyeri A, 2008
Effect of Exercise on Falls

- Exercise-focused interventions for community-dwelling older people
- Tai chi, gait, and balance training
- Home safety assessment (effective in those at high risk for falls)
- Cataract removal


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Effect of Exercise on Falls

The pooled estimate of the effect of exercise on the rate of falls indicates a 16% reduction (pooled rate ratio 0.84 (95% CI: 0.77 – 0.91); 54 trials)

<table>
<thead>
<tr>
<th>Component type or dose (number of studies)</th>
<th>Reduction in falls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reduced rate (%), 95% CI</td>
</tr>
<tr>
<td>Exercise with moderate or high challenge to balance (43)</td>
<td>22, 14 - 30</td>
</tr>
<tr>
<td>Exercise with a high challenge to balance (30)</td>
<td>25, 15 - 43</td>
</tr>
<tr>
<td>Total exercise dose more than 50 hours (30)</td>
<td>23, 13 - 32</td>
</tr>
<tr>
<td>Inclusion of walking training (30)</td>
<td>10, 0 - 22</td>
</tr>
<tr>
<td>A high risk population (39)</td>
<td>10, 0 - 20</td>
</tr>
</tbody>
</table>

Sherrington et al., 2011, NSW Public Health Bulletin
New! Effect of Exercise on Falls

Results of multivariate meta-regression exploring impact of trial-level characteristics on the effect of exercise on falls in community-dwelling older populations.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Effect on falls, IRR (95% CI), p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High challenge balance training*</td>
<td>0.79 (0.71 - 0.88), &lt;0.001</td>
</tr>
<tr>
<td>3+ hours per week of intervention</td>
<td>0.70 (0.60 - 0.83), &lt;0.001</td>
</tr>
<tr>
<td>Neither high challenge or 3+ hours</td>
<td>0.90 (0.82 - 0.99), 0.03</td>
</tr>
<tr>
<td>High challenge balance training AND 3+ hours per week of intervention**</td>
<td>0.61 (0.53 - 0.72), &lt;0.001</td>
</tr>
</tbody>
</table>

* High challenge includes: movement of center of mass, narrowing of the base of support and minimizing upper limb support. **Note: 72% heterogeneity explained by both variables; statistically significant comparisons in italics

- Exercise reduces fall rates in community-dwelling older adults by 21%.
- 3 hours per week AND high challenge to balance reduces falls by 39%!

Effect of Mechanical Loads on Vertebral Fracture Risk

- Body posture or activity
- Falls
- Height & weight
- Muscle forces
- Spinal curvature
- Disc degeneration
- Neuromuscular control

Christiansen & Bouxsein, Current Osteoporosis Reports. 2010; 8:198–204
Hyperkyphosis

Centre of mass above vertebra moves anterior = ↑ flexion moment

Hyperkyphosis

Compression fracture

↑ compression of vertebral body

Compression fracture increases kyphosis

Larger extensor forces required to stabilize the spine

Larger extensor forces

Extensors in lengthened position, lever arms shorter, larger forces required

Compression fracture

Weight of head and torso and muscle forces contribute to compression

Effect of Exercise on Hyperkyphosis

• Small # of clinical trials report modest improvements in clinical measures of kyphosis with exercise
• Emphasis on back extensor muscle strength/endurance
• New! SHEAF high quality randomized trial results report significant improvement in radiographic and clinical kyphosis with spine strengthening exercise and postural training

Katzman, WB, et al. Osteoporos Int, in press
Guidelines for physical activity essential to healthy aging

If you're 65 years of age or older, are generally fit, and have no limiting health conditions follow the guidelines listed below for physical activity recommendations.

- 150 minutes of moderate-intensity aerobic activity (i.e., brisk walking) OR 75 minutes of vigorous-intensity aerobic activity (i.e., jogging or running) every week

- weight training muscle-strengthening activities on 2 or more days a week that work all major muscle groups (legs, hips, back, abdomen, chest, shoulders, and arms)

- daily posture exercise and balance training to prevent falls
What is “Too Fit To Fracture”? 

- Establish expert consensus
- Delphi consensus process
- Exercise and physical activity recommendations for individuals with osteoporosis, with or without vertebral fracture
- Knowledge translation
- Establish research priorities, collaborations, plans for action

Slide modified and courtesy of L. Giangregorio and Osteoporosis Canada

“Too Fit to Fracture” Exercise Recommendations

Expert consensus and best evidence support:

1. Accumulation of ≥ 30 minutes/day moderate/vigorous aerobic physical activity*
2. Strength training ≥ 2 times a week*
3. Balance training daily
4. Exercises for back extensor muscles, posture daily
5. Spine sparing strategies like hip hinge and step-to turn can ↓ spine loads → how to move, rather than how not to move

*If vertebral fracture: moderate, not vigorous intensity; alignment more important than intensity

“Too Fit To Fracture”
Exercise Recommendations

Recommendations for older adults with osteoporosis or osteoporotic vertebral fracture:

• Engage in a multicomponent exercise program that includes resistance training in combination with balance training.
• Do not engage in aerobic training to the exclusion of resistance or balance training.

Consult a physical therapist to ensure safe and appropriate exercise if you have a spine fracture.


For Better Balance

High balance challenge
• Movement of the center of mass (shifting weight to limits of stability, 3-dimensional movement like Tai Chi, dynamic balance like figure 8, squat steps)
• Narrow the base of support (one-legged, tandem)
• Minimizing upper limb support (finger-tip or no support)
For Stronger Back Muscles

What type of activity?
Supine isometrics → prone extension to neutral → core activation in standing

How often each week?
• 5-10 minutes per day of posture exercises
• Attention to posture during daily activities
Tools: Floor mat or soft but supportive surface, mirror, wall

Individuals with a history of a spine fracture:
• Might need a pillow under head if spine is curved
• Supine lying at intervals throughout the day “unloads” spine, promotes spinal extension and stretches front shoulders and chest.
• Consultation with a trained professional

Giangregorio LM, et al Too Fit To Fracture: Outcomes of a Delphi consensus process on physical activity and exercise recommendations for adults with osteoporosis with or without vertebral fractures. Osteoporos Int. 2014

For Stronger Back Muscles
For those with spine fractures and pain

For pain, supine lying 15-20 min, 2-4x/day
Lie on your back, bend both knees with feet flat on the floor. Use a pillow if your head does not touch the floor. Place both arms out from your side, about 30-45 degrees, with palms facing up.
When beyond acute stage, can begin to add exercises for back extensors.
Lift the breastbone while keeping your back in contact with the floor. Hold for 3-5 seconds and repeat 8-12 times.
For Stronger Back Muscles

Alphabet exercise

Ball, JM, et al. Osteoporos Int, 2009

More demanding positions
More complex moves
- Add therabands or weights for increased strength
- Increase duration or repetitions for increased endurance
For Better Posture

Align:
- Back of head
- Shoulder blades
- Rib cage
- Buttocks/sacrum
- Feet

Practice best posture throughout the day

Posture Cues

<table>
<thead>
<tr>
<th>Target</th>
<th>Example Cues</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forward head posture</strong></td>
<td>• Imagine the head aligned over the shoulders, pelvis and feet</td>
</tr>
<tr>
<td></td>
<td>• Lengthen through the crown of the head</td>
</tr>
<tr>
<td><strong>Hyperkyphosis, rounded shoulders</strong></td>
<td>• “Romeo and Juliet” abdominals up and shoulders down</td>
</tr>
<tr>
<td></td>
<td>• Show off jeweled necklace</td>
</tr>
<tr>
<td></td>
<td>• Breathe into the concavity of your back and pelvis.</td>
</tr>
<tr>
<td><strong>Core stability</strong></td>
<td>• Gently brace your abdomen as if someone were about to poke you in the stomach.</td>
</tr>
</tbody>
</table>
What is “spine sparing”? Recommend that patient modify activities that apply rapid, repetitive, weighted or end-range flexion (forward bending) or twisting torque to the spine.

How?
- Hip hinge
- Step-to-turn
- Avoid lifting from/lowering to floor
- Slow, controlled twist, not to end of range of motion
- Balance loads on either side of body
- Support trunk when flexing
- Hold weight close to body, not overhead

Teach “spine sparing” during ADL and physical activity Recommend that patient modify activities that apply rapid, repetitive, weighted or end-range flexion (forward bending) or twisting torque to the spine.

Saying “Don’t bend or twist” doesn’t teach how TO move → instills fear, disincentive to physical activity.

Slide courtesy L. Giangregorio; Osteoporosis Canada
Harms of Exercise?

- Unsafe exercises
- Unsafe transitions
- Tailor to ability, preference, health status
- Appropriate progression

AVOID: flexion, rounding, twisting

Photos: Do It Right, American Bone Health, Sherri Betz, PT, GCS

Slide courtesy L. Giangregorio; Osteoporosis Canada
Should physical activity recommendations vary across individuals?
Consider: vertebral fracture, current health, physical function, activity history, desire

Osteoporosis, no vertebral fracture:
If history or strong desire, can you modify?
Spine sparing!

Avoid high-impact sports, high fall risk or contact sports
→ do low impact, slower pace

Osteoporosis with vertebral fracture, gait & balance difficulties, hyperkyphosis or pain:
Alignment, spine sparing more important than intensity
Moderate intensity aerobic physical activity
May need trained instructor for classes, physical therapist re: ADLs
Get help beyond light ADLs, avoid sitting long periods
Supine lying “unloads” the spine, promotes extension, pain relief
KEY Messages

- Exercise may reduce fractures:
  - Can prevent falls, even in those at high risk
  - May maintain bone density or bone strength
  - Can improve posture and reduce applied loads
- Strong and consistent evidence for positive effect on mortality, disability, other health outcomes…..
- Recommend multicomponent exercise programs – resistance, aerobic training, balance, posture

Resources

National Osteoporosis Foundation Health Professional’s Guide to Rehabilitation of the Patient with Osteoporosis [www.nof.org](http://www.nof.org)
American Bone Health [https://americanbonehealth.org/what-you-should-know/exercise](https://americanbonehealth.org/what-you-should-know/exercise)
WHO Fracture Assessment Tool [http://www.shef.ac.uk/FRAX/tool.jsp](http://www.shef.ac.uk/FRAX/tool.jsp)
Stand Tall™ exercise videos [www.geriatricspt.org/store/wellness@ptrehab.ucsf.edu](http://www.geriatricspt.org/store/wellness@ptrehab.ucsf.edu)
Health and Wellness exercise classes (UCSF PT and Rehab Science) [wellness@ptrehab.ucsf.edu](mailto:wellness@ptrehab.ucsf.edu)
Too Fit to Fall or Fracture

Strength Training
- At least 2 days/week
- Preferably 3 days/week:
  - Legs
  - Arms
  - Core
- Use free weights, bands, or machines
- 3-12 repetitions per exercise

Balance Exercises
- Every day
  - Sit, stand, sitting, walking, on your feet or on hands
  - More weight shift, one food or two
  - Keep weight between 2 legs while stopping, standing, bending, sitting

Posture Awareness
- Daily
  - If you have back problems, avoid long periods of sitting, lying on bed, or lifting your shodded feet

Aerobic Physical Activity
- Heart rate (HRR or HRmax)
  - Start with light intensity
  - Increase exercise intensity
  - End with light intensity

Strength Training (more examples)
- One repetition maximum
- Use weights
- 3-12 reps

What are spine stretching strategies?
- Yoga: using poses with “spine stretch” to stretch the spine and stretch your muscles
- Tai Chi: slow, controlled movements
- Pilates: low-impact exercises

Spine stretching strategies:
- Stand with your legs apart, back straight, hands on hips
- Turn your whole body rather than twisting your spine

Useful and next steps

http://www.osteoporosis.ca/osteoporosis-and-you/too-fit-to-fracture/