Conquering the Epidemic of Fractures: A Challenge for 21st Century Clinicians

Joan M. Lappe, PhD, RN, FAAN
Criss/Beirne Professor of Nursing
Professor of Medicine, Osteoporosis Research Center
Creighton University
Omaha, Nebraska

Objectives

1. Stimulate your interest in addressing the epidemic of osteoporotic fractures
2. Review the information needed to meet the challenge: definition of osteoporosis and osteoporotic fracture, epidemiology, pathophysiology, screening, and state of the science for prevention and treatment.
3. Provide resources for more information and updates.

Osteoporosis

Systemic skeletal disease characterized by:
- microarchitectural deterioration of bone tissue
- low bone mass
- a consequent increase in bone fragility and susceptibility to fracture.

Bone Remodeling

Bone mass across the life span with optimal and suboptimal lifestyle choices

Dr. Lappe has no conflicts to disclose
Osteoporotic Fracture

Fracture due to trauma equal to, or less than, a fall to the floor from a standing height

Excludes fractures of the digits, face or skull.

Osteoporotic Fractures Are Common

One out of every two women age 50 and older will have an osteoporotic fracture during her lifetime:

(One of ten will develop breast cancer.)

One out of every four men age 50 and older will have an osteoporotic fracture during his lifetime:

(One out of three are diagnosed with prostate cancer.)

Fracture Epidemiology

- 2 Million Bone Fractures Annually Including
  - Hip Fractures
  - Vertebral Fractures
  - Wrist Fractures

Risk of Hip Fracture: Age-Specific Incidence Rates in the Framingham Study

As an increased number of people are living longer, this is becoming more a public health problem.

Eg Methodist Women’s Hospital volunteer going strong at age 98

Osteoporosis Is Serious

20-30% of hip fracture patients die within a year of their injury.

25% require long-term nursing home care.
Impact of Vertebral Fractures

- Acute back pain
- Chronic back pain
- Height loss
- Thoracic kyphosis
- Lumbar lordosis and protuberant abdomen
- Abdominal discomfort
- Rib and pelvic discomfort
- Reduced pulmonary capacity
- Early satiety and weight loss
- Loss of self esteem
- Sleep disorders


Lifestyle factors affecting Bone Health

- Dietary calcium
- Weight-bearing exercise
- Vitamin D
- Cigarette smoking
- Alcohol abuse

Calcium Physiology

- Calcium is critical for metabolic functions such as cell signaling, blood clotting, muscle contraction and nerve function.
- Bone serves as a reservoir of calcium for metabolic functions
- Serum calcium is tightly regulated.
- The body depends on dietary intake as a source of calcium.
- If calcium intake falls below required levels, calcium is pulled from the skeletal reservoir.
- Long-term calcium deficiency depletes the reserve and subsequently decreases bone mass and strength.

Recommended calcium intakes per day from all sources

<table>
<thead>
<tr>
<th>Age</th>
<th>Male (mg/d)</th>
<th>Female (mg/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3 yr</td>
<td>700</td>
<td>500</td>
</tr>
<tr>
<td>4-8 yr</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>9-18 yr</td>
<td>1,300</td>
<td>1,300</td>
</tr>
<tr>
<td>19-50 yr</td>
<td>1,000</td>
<td>1,200</td>
</tr>
<tr>
<td>51-70 yr males</td>
<td>1,000</td>
<td>1,200</td>
</tr>
<tr>
<td>51-70 yr females</td>
<td>1,200</td>
<td>1,200</td>
</tr>
<tr>
<td>&gt; 70 yrs</td>
<td>1,200</td>
<td>1,200</td>
</tr>
</tbody>
</table>

8 oz milk = 300 mg
Calcium Supplements

For maximum absorption:
- Take calcium supplements with food
- Disperse doses throughout the day

Calcium phosphate is a good choice for persons with deficient protein intake—many older adults.

Do calcium supplements cause heart attacks and kidney stones?

Well-designed studies show that calcium does not cause heart attacks or kidney stones. In fact, studies with good designs have shown that calcium supplements do not cause calcification of the heart arteries, which leads to heart attacks. Also, large well-designed studies have shown that calcium supplement may prevent kidney stones.

Promoting Bone Health with Exercise

- Exercise regularly, at least 30 minutes every day.
- Work for bones means handling impact, resistance equal to the weight of your body or greater.

Weight-bearing physical activity (loading the bones)
- Lower body – walking, running, gardening
- Upper body – racquet sports, resistance training

Swimming and cycling provide good cardio workouts and build muscle but do not load the bones directly.

Children and adolescents need physical activity to increase peak bone mass, which is achieved by about age 25.

In adults, weight-bearing physical activity is essential to maintain bone.
Maintaining muscle strength is important for prevention of falls, the leading cause of osteoporotic fractures. Exercises to maintain balance are also important. Yoga is one approach.

**Caution!**

Patients diagnosed with low bone mass or osteoporosis should get advice of a trained physical therapist before proceeding with resistance training such as weight lifting or using resistance equipment.

**Vitamin D Physiology**
- Serum 25 hydroxyvitamin D (25(OH)D) is the functional indicator of vitamin D status.
- Serum 1,25 dihydroxyvitamin D (1,25(OH)_2D) is the active metabolite of vitamin D.
- *Indirect* action of vitamin D on bone is facilitation of intestinal calcium (and phosphorus) absorption.
- *Direct* effects of 25(OH)D and 1,25(OH)_2D on all bone cells have been demonstrated.


**Hypovitaminosis D is epidemic in the U.S.**

Lappe et al., *JACN* 2006

**Factors Affecting Conversion of Vitamin D in the Skin**
- The darker the skin the less the production of vitamin D.
- During the winter at latitudes above and below ~35° little vitamin D is produced.
- Aging decreases conversion of vitamin D in the skin. (reduced fourfold in a 70-yr old compared to a 20-yr old.)
- Sunscreen prevents 97-100% conversion of vitamin D in the skin

**Other Factors Associated with Low Vitamin D**
- Overweight
- Medications – seizure medications, corticosteroids
Hypovitaminosis D is epidemic in the U.S.

Vitamin D intake is recommended by the National Academy of Science to be 400-800 International Units (IU's) per day.

However, the level of intake needed to achieve 30 ng/ml varies widely among individuals.

Supplements are widely available.

Intake up to 4000 IU/day is considered safe.

Change in Spine BMD Across Menopause

- Estrogen-deprivation bone loss begins about two years prior to last menses.
- Bone loss is completed over 6 years.
- On average spine bone loss averaged 10.5%.

Diagnosis of Osteoporosis

The only way to detect osteoporosis before a fracture occurs is through bone mineral density (BMD) testing.

National Osteoporosis Foundation (NOF)

T-Score

Interpreting Bone Mass Measurement Reports

T-Score

Interpreted as standard deviation (SD) below peak bone mass of young adults.
Osteoporosis Definition (WHO)

Referent: young adult mean BMD (Bone mineral density)

<table>
<thead>
<tr>
<th>Category</th>
<th>T-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>down to 1 standard deviations (sd) below referent</td>
</tr>
<tr>
<td>Osteopenia</td>
<td>– 1 to –2.5 sd below referent</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>&gt;2.5 sd below referent</td>
</tr>
<tr>
<td></td>
<td>Established osteoporosis: fragility fracture</td>
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</tbody>
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When to do Bone Density Testing?

Medicare guidelines:
Bone density testing for women ≥ 65 and men ≥ 70.

Others should be tested if they have risk factors:
For example, perimenopausal women who are skipping periods or having hot flashes, individuals with a low-trauma fracture after age 50.

Risk Factors for Osteoporotic Fractures: Need for DXA Screening

- Caucasian Race
- Estrogen Deficiency (skipping periods, hot flashes)
- History of Osteoporosis in 1st Relative
- Inadequate Physical Activity
- Female Sex
- Dementia
- Poor Health/Frailty
- Smoking
- Low Body Weight
- Low Calcium Intake
- Alcoholism
- Impaired Visual Acuity
- Recurrent Falls
- Advanced Age

Medications and Secondary Causes

- Corticosteroids
- Diabetes
- Antidepressants
- Malabsorption syndromes
- Antiseizure meds
- Gluten enteropathy
- Bariatric surgery
- Inflammatory arthritis
Any broken bones in people over the age of 50 from standing height that are not caused by a serious accident (car crash, falling off a ladder, etc.) can be the first sign of low bone density or osteoporosis.

Broken bones from tripping on the sidewalk or falling over something on the floor at home are often related to osteoporosis, yet frequently undiagnosed.

Thus, it is important to assess details of the events associated with the fracture.

Compared to expected fracture rates in the community, the risk of a hip fracture following the index forearm fracture was increased 1.4-fold in women (95% CI, 1.1–1.8) and 2.7-fold in men (95% CI, 0.98–5.8).

Cuddihy et al, Osteo 1999; Crandall, JBMR 2015

Any fracture after age 50 increases the risk of hip fracture by 1.5X

Cummings et al, Lancet 2002

Medications for Osteoporosis

- Bisphosphonates – inhibit osteoclasts
  - risedronate
  - alendronate
  - zolendronate
  - ibandronate
- Parathyroid hormone – stimulates osteoblasts to build new bone
  - teriparatide
  - abaloparatide
- Monoclonal rank-ligand antibody - inhibits formation of osteoclasts
  - denosumab
- Monoclonal sclerostin antibody - stimulates osteoblasts to build new bone
  - romosozumab
- Estrogen replacement – decreases perimenopausal bone loss
- Selective estrogen receptor modulator (SERM) – similar to estrogen
  - raloxifene

Hip Protectors

Study Population
N = 1801
Age >70
N = 653 Treated
N = 1148 Controls
All ambulatory with one risk factor for hip fracture.

Hip Fractures Over Two Years (Intention-to-Treat)

RR = 0.34
Does Osteoporosis Suffer from Ageism and Sexism?

Although treatment options are available that prevent up to 70% of osteoporotic fractures, only 4-20% of patients with osteoporotic hip fracture are treated. (Would that happen with hypertension?)

Patient Adherence to Oral Bisphosphonates Is Poor

A recent systematic review of the literature, that included 89 studies of adherence to oral bisphosphonates, found that the mean adherence to oral bisphosphonates was:

- 6 months: 38% to 79%,
- 1 year: 13% to 78%,
- 2 years: 10% to 42%  

Furthermore, a recent study found that media reports contribute to poor adherence.

Fracture Liaison Services (FLS)

Coordinator-based, secondary fracture prevention services implemented by health care systems for the treatment of osteoporotic fracture patients designed to:

- Close the care gap for fracture patients, 80-90% of whom are currently never offered screening and/or treatment for osteoporosis
- Enhance communication between health care providers by providing a care pathway for the treatment of fragility fracture patients.
Fracture Liaison Services: Structure

- Made up of a committed team of stakeholders, employs a dedicated coordinator to act as the link between the patient and the orthopedic team, the osteoporosis and falls prevention services, and the primary care physician.
- Ensures that all patients presenting with fragility fractures to the clinic/institution receive fracture risk assessment and treatment as appropriate. The dedicated coordinator, often a clinical nurse specialist, uses pre-agreed protocols to case-find and assess fracture patients.
- The NOF does offer a FLS “Bundle FLS” on-line along with a Certificate of Completion. https://cme.nof.org/Activity/6614146/Detail.aspx

Bone Health TeleECHO Clinic

- Weekly video conferences with interactive case-based learning and short didactic presentations.
- The Bone Health TeleECHO team consists of E. Michael Lewiecki, MD at the U of New Mexico, and other specialists with expertise in the care of osteoporosis and other bone disorders.
- The aim of Bone Health TeleECHO is to improve the care of patients with osteoporosis and reduce the osteoporosis treatment gap.
- Tuesdays, 12:00 pm-1:15 pm (MST)
  - https://echo.unm.edu/bone-health-teleecho-programs/bone-health/

Interdisciplinary Symposium on Osteoporosis

May 15-18, 2019 in La Jolla, CA.

- Registration is now open
  - https://interdisciplinarysymposiumosteoporosis.org/registration-2/
- ISO19 offers sessions and networking opportunities for medical disciplines and specialties working with patients who have and/or are at risk for osteoporosis and fractures.
- Earn the Fracture Liaison Service (FLS or FLS Advanced) Certificate of Completion on-site

Summary

- Osteoporosis is a public health problem that has grave consequences for individuals, families and the nation.
- Research evidence supports interventions to build and maintain bone mass and quality.
- Low trauma fractures after age 50 are an obvious clue to underlying osteoporosis.
- State of the art screening is available to detect persons who are risk for osteoporosis (have not fractured) and in whom treatment might prevent any fractures.
- However, osteoporosis is under-diagnosed and under-treated.
- Furthermore, adherence is poor in those who are treated.

Conclusion

A multitude of resources are available to decrease the burden of osteoporosis in this country.

Clinicians from every health care discipline are needed to join in the effort which includes assessing bone health in all patients, especially those over 50; educating clients/patients about osteoporosis; and being alert for patients who have already experienced an osteoporotic fracture.

Any patient/client who has risk factors or a fragility fracture should be referred for appropriate evaluation and treatment.

To ensure adherence, treated patients need education and follow up since adherence is known to be very low in this patient population.
Creighton University