Bare Bones to Big Business: Osteoporosis Programming for Your Practice

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Disclosure

• Marilyn Moffat and Karen Kemmis do not have any relationship that could reasonably be viewed as creating a conflict of interest, or the appearance of a conflict of interest, that might bias the content of the presentation; nor have they received any financial or research support for this program; nor do they receive any product development salaries.
Objectives

Following this presentation, you will be able to:

• Describe the anatomy, physiology, incidence and pathophysiology of osteoporosis and low bone mineral density (BMD) and the relationship between osteoporosis and risk of fracture

• Perform tests and measures to examine the person with osteoporosis

• Know appropriate, evidence-based exercise interventions to enhance bone density and decrease fall risk

• Establish equipment, space, personnel, and marketing needs to promote successful programming for patients/clients with osteoporosis and low BMD

OSTEOPOROSIS

The Realities and the Future
The Realities and the Future

- Osteoporosis and low bone mineral density (BMD) affect 54 million Americans (60% of people ≥50 years of age)
- Those with osteoporosis and low BMD are at increased risk of traumatic and non-traumatic fractures
- The estimate for incident fracture is >2 million per year costing over $19 billion

(NOF Fast Facts. Available at http://www.nof.org/articles/7 )
The Realities and the Future

• By 2025, annual fractures are predicted to increase about 50% with a cost of $25.3 billion
• Most rapid growth in people aged 65-74 yrs, ↑ >87%
• Physical therapists have the opportunity to assess for risk of osteoporosis and increased risk of falls and can carry out interventions to prevent bone loss, falls, and fractures!

OSTEOPOROSIS

Anatomy and Physiology
Definition of Osteoporosis
Incidence of Osteoporosis
Pathophysiology
Diagnosis
ANATOMY

Bone Composition

- Specialized connective tissue
- Consists of matrix and cells
  - Matrix made up of organic and inorganic components
    - Organic component (20-25%) made up of collagen, mucopolysaccharides, and non-collagenous proteins
    - Inorganic component (50-55%) made up calcium and phosphorus, which is a distinguishing feature of bone
      - High content of inorganic material gives bone its rigidity
  - Water makes up the last 25% of bone
Cells

- Osteoblasts – the bone forming cells responsible for synthesis and mineralization of bone during formation and remodeling
- Osteoclasts – the cells that dissolve bone by removing mineralized matrix and breaking up organic bone

Macroscopic Structure

- Compact bone (also called dense or cortical bone) - contained in the long bones - solid outer shell
- Spongy bone (also called cancellous, trabecular, and medullary bone) - extremely porous - highly vascularized - contains red marrow - area of blood cell production
Bone Formation

- During childhood and teenage years, new bone added faster than old bone removed
- Thus, bones become larger, heavier, and denser

http://www.bing.com/images/search?q=bone+remodeling&qpvt=bone+remodeling&FORM=IGRE#view=detail&id=3E5FD709D62C63302C6BB4EBC908771B8E4D353&selectedIn
Bone Formation

- Bone formation continues at a pace faster than resorption until peak bone mass (maximum bone density and strength) is reached around age 30
- > 30 years steady ↓ favors resorption (Lundon, 2000)
- Remodeling is an active process due to the activity of osteoblasts (formation) and osteoclasts (resorption)

Bone Through the Life Cycle

- Bone loss is exaggerated in menopause, 20-30% loss of cancellous and 5-10% loss of cortical for 4-8 years
- Bone loss is most rapid in the first few years after menopause but persists into the postmenopausal years
- Women can lose up to 20% of their bone mass in the 5 - 7 years following menopause
- Rate of 20-25% loss through rest of life in postmenopausal women and adult men (Riggs et al, 2000)
- Altered by hormones, nutrition, some diseases, and lifestyle factors (Johnson, 2003; Lundon, 2000; NOF. Fast Facts, 2010)
Bone Through the Life Cycle

- After age 30 resorption slowly exceeds formation
DEFINITION OF OSTEOPOROSIS

“Osteoporosis, or porous bone, is a disease characterized by low bone mass and structural deterioration of bone tissue, leading to bone fragility and an increased susceptibility to fractures of the hip, spine, and wrist. Men as well as women are affected by osteoporosis, a disease that can be prevented and treated.”

INCIDENCE OF OSTEOPOROSIS

Recent Prevalence of Osteoporosis and Low Bone Mass in the US Based on BMD (Femoral Neck or Lumbar Spine)

(Wright NC, Looker AC, Saag KG. 2014)
PATHOPHYSIOLOGY OF
OSTEOPOROSIS

Osteoporosis

- Hereditary factors: genetics account for up to 80% variance in peak bone mass
- OP more likely to develop if optimal bone mass was not achieved during bone building years
- Initial bone loss in osteoporosis in spongy bone (vertebral bodies, proximal femur, distal radius) (Lundon, 2000)
Osteoporosis – Type I

- Type I or postmenopausal - decrease in estrogen levels affects trabecular bone by increasing osteoclastic activity
- Usually results in vertebral and distal radial fractures
- Usually in women 51-75 years of age

Osteoporosis – Type II

- Type II or senile/involutional begins in the third decade
- Gradual loss of bone due to drop in vitamin D synthesis (lack Ca++ absorption) or increased parathyroid activity (increases osteoclastic activity)
- Usually bone density changes arrive at low bone mass/osteoporosis levels over the age of 70
Osteoporosis – Secondary

- Result of some other clinical disorder
- Medical conditions (RA, COPD, anorexia nervosa and bulimia, MS, malabsorption syndromes [i.e., celiac disease], kidney failure, liver impairment)
- Hormonal causes (hyperparathyroidism, hyperthyroidism, diabetes, hypercortisolism)
- Medications or chemicals (corticosteroid use, cigarette smoking, alcohol abuse, antacids containing aluminum)
- Other (sarcopenia, leukemia, metastatic bone disease)

(©F at http://www.iofbonehealth.org/secondary-osteoporosis)

DIAGNOSING OSTEOPOROSIS
Diagnosis of Osteoporosis

Fragility of bone or decreased density

1. Density: DXA to compare the person’s density to young adult reference mean (~30 y.o.)

2. Fragility of bone: non-traumatic fx
   - Non-traumatic or low trauma fracture
     • From fall of standing height or less
   - Loss of >4 cm from max height, confirm with x-ray

Complete Diagnostic Evaluation

• Bone mineral density

• Vertebral imaging

• Measure height annually: wall-mounted stadiometer

• Assess for secondary causes of osteoporosis
Bone Mineral Density Testing

- All methods measure bones ability to absorb radiation and/or sound waves to determine density
- DXA = Dual-energy X-ray Absorptiometry (gold standard) measures the spine, hip, wrist, or total body
- Other methods are accurate at the site measured
- Should measure sites of greatest concern for fracture (DXA)

DXA Interpretation

T-score:
- Compares bone density to average density of young healthy adults of same gender
- Expressed in standard deviations above and below the average

<table>
<thead>
<tr>
<th>Osteoporosis</th>
<th>Low Bone Mass</th>
<th>Normal Bone Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-2.5 and lower)</td>
<td>(Between -1.0 and -2.5)</td>
<td>( -1.0 and above)</td>
</tr>
<tr>
<td>… -3.5 … -3.0 … -2.5 … -2.4 … -2.0 … -1.5 … -1.1 … -1.0 … 0.0 … +1.5 … +2.0 …</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Vertebral Imaging

- Should be considered in the following:
  - All women ≥ 70 and all men ≥ 80 if BMD T-score at spine, total hip, or femoral neck is ≤ 1.0
  - Women 65-69 and men 70-79 if BMD T-score at spine, total hip, or femoral neck is ≤ 1.5
  - Postmenopausal women and men 50+ with specific risk factors
    - Low trauma fx during adulthood (age 50)
    - Historical height loss of ≥ 1.5 inches (4 cm)
    - Prospective height lost of ≥ 0.8 inches (2 cm)
    - Recent or ongoing long term glucocorticoid treatment

(NOIF. Available at http://nof.org/files/nof/public/content/file/2791/upload/919.pdf.)
Physical Signs to Screen for Osteoporosis

- Data analyses provided positive likelihood ratios for the following factors related to OP diagnosis
  - Rib pelvis distance less than 2 finger breadths (+LR = 3.8)
  - Wall occiput distance greater than 0 cm (+LR = 4.6)
  - Weight less than 51 kg (112.44 lbs) (+LR = 7.3)
  - Tooth count less than 20 (+LR = 3.4)
  - Self-reported humped back (+LR = 3.0)
  - Can change pre-test probability and suggest need for earlier screening

(Green AD, et al, 2004)
### Risk Factors for Osteoporosis and Fracture

- Low BMD confers ↑ risk for fracture

- A prior fracture is associated with an 86% increased risk of any fracture

- Wrist fracture

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### Risk Factors for Osteoporosis and Fracture

- A 10% loss of bone mass in the vertebrae can double the risk of vertebral fractures

- A 10% loss of bone mass in the hip leads to 2.5 times ↑ in risk of hip fracture

- Men and women with annual height loss >0.5 cm are at ↑ risk of hip and any fracture

(NOJ Fast Facts. Available at [http://www.nof.org/articles/7](http://www.nof.org/articles/7))
Risk Factors for Osteoporosis and Fracture

Modifiable risks
- Alcohol
- Smoking
- Low body mass index
- Poor nutrition
- Vitamin D deficiency
- Eating disorders
- Insufficient exercise
- Low dietary calcium intake
- Frequent falls

Risk Factors for Osteoporosis and Fracture

Non-modifiable and ‘secondary risk factors’
- Age
- Female gender
- Family history of osteoporosis
- Previous fracture
- Ethnicity (White or Asian, although those who are Black and Hispanic are at substantial risk as well)
- Menopause/hysterectomy
- Long term glucocorticoid therapy
- Rheumatoid arthritis
- Primary/secondary hypogonadism in men
- Gastric bypass

(International Osteoporosis Foundation at http://www.iofbonehealth.org/whos-risk)
FRAX®-Risk Assessment Tool

- WHO tool to evaluate fx risk based on patient models that integrate risks associated with clinical risk factors and femoral neck BMD
- Gives 10-year probability of hip fx and of a major OP fx (spine, forearm, hip, or shoulder) which should lead to better treatment decisions
- Computer driven tool online for those between 40-90 yrs – http://www.shef.ac.uk/FRAX
- Also available in paper version on same site and can be downloaded for office use
- Available for 4 US populations – Caucasian, Black, Hispanic, and Asian
- Not every possible contributor to risk factored in

FRAX®-Risk Assessment Tool

12 FACTORS ASSESSED

- Age/Date of birth
- Sex
- Weight (kg)
- Height (cm)
- Previous fracture
- Parent fractured hip
- Current smoking
- Glucocorticoids
- Rheumatoid arthritis
- Secondary osteoporosis (type 1 diabetes, liver disease, hyperthyroidism, osteogenesis imperfecta)
- Alcohol 3 or more units per day
- ±Femoral neck BMD (g/cm²)
FRAX® Tool

- Does not include all known risk factors
  - Falls
- Lacks detail on some risk factors:
  - Dose response effects of glucocorticoids, smoking, prior fracture, etc.
- Depends on adequacy of epidemiological information
- Model relevant only for untreated patients
- Does not replace clinical judgment

Adapted from:

Risk Factors for Fracture

- Movement impairment
  - Impaired neuromuscular function (e.g., reduced muscle strength, impaired gait and balance)
    - Use of arms to stand up from chair (↑ 1.77)
    - Delayed foot response time (↑ 1.44)
    - Decreased depth perception (↑ 1.39)
    - Impaired cognition (↑ 1.25-1.36)
    - Any ADL impairments (↑ 1.35)
    - Decreased quad strength (↑ 1.28)
    - Slower walking speed (↑ 1.25)

(Taylor BC et al, 2004)
“Falls are not an inevitable part of aging. There are specific things that you, as their health care provider, can do to reduce their chances of falling. STEADI's tools and educational materials will help you to:

– Identify patients at low, moderate, and high risk for a fall;
– Identify modifiable risk factors; and
– Offer effective interventions”

• Materials for providers
• Videos for providers
• Materials for patients

(CDC at http://www.cdc.gov/steadi/)

• 3 Questions to Ask Your Older Adult Patients
  – When you see patients 65 and older, make these three questions a routine part of your exam:
    • Have you fallen in the past year?
    • Do you feel unsteady when standing or walking?
    • Do you worry about falling?

• If your patient answers "yes" to any of these key screening questions, they are considered at increased risk of falling. Further assessment is recommended.

(CDC at http://www.cdc.gov/steadi/)
Osteoporosis and Fractures


Osteoporosis and Fractures

Tests and Measures

PHYSICAL THERAPY EXAMINATION OF THE PERSON WITH OSTEOPOROSIS

POSTURE TESTS & MEASURES

- Historical height loss
- Wall-occiput distance
- Rib-pelvis distance

ACCURATE MEASURE OF HEIGHT

Stadiometer
Historical Height Loss

- To detect clinically the likelihood of the prevalence of a vertebral fracture(s)  
  (Siminoski K, et al, 2006)
- Historical height loss (HHL) = difference between a patient’s/client’s tallest recalled height (TRH) and current measured height (MH) (Schousboe JT, et al, 2008)
- HHL of $>4$ cm (1.6 in) suggests incident of a vertebral fracture (Siminoski K, et al, 2006)
- HHL of 6.1-8.0 cm (2.4-3.1 in) LR+ 2.8 of vertebral fracture (Schousboe JT, et al, 2008)
- HHL > 8.0 cm (3.1 in) LR+ 9.8 of vertebral fracture (Schousboe JT, et al, 2008)
- Patients/clients with HHL $>4.0$ cm should have spine radiograph (Schousboe JT, et al, 2008; Siminoski K, et al, 2006)

WALL-OCCIPUT DISTANCE

- To test for occult thoracic vertebral fracture(s)
Wall-Occiput Distance Procedures

- Stand straight with back against a wall with heels touching wall
- While keeping back flat against the wall, try to put head against the wall
- Keeping head against the wall, try to straighten up as much as possible so that the back of neck is as close to the wall as possible
- Measure the distance between the occipital prominence and the wall

Wall-Occiput Distance Procedures

- Scoring
  - The inability to touch the wall with the back of the head is + finding
  - A wall-occiput distance (WOD) of 0 cm reduces the chance of thoracic fracture but does not reliably rule it out
  - WOD increases 1.2 cm for every vertebral fracture
  - WOD 4.1-6.0 cm odds ratio 8.2, LR+ 3.2 for prevalent fracture
  - WOD > 6 cm odds ratio 17.8, LR+ 6.9 for prevalent vertebral fracture
  - Consider spine radiograph > 4 cm WOD

(Siminoski K, et al, 2011)
RIB PELVIS DISTANCE

• To test for occult lumbar vertebral fracture(s)
• To determine if rib-pelvis distance may be indicative of suspected osteoporosis related to vertebral compression fractures

Rib-Pelvis Distance Procedures

• Have individual raise arms parallel to the floor
• Measure the distance from the inferior margin of the ribs to the superior surface of the pelvis in the midaxillary line
  (Siminoski K, et al, 2003)
Rib-Pelvis Distance Scoring

- A positive test is defined as a distance of ≤ 2 fingerbreadths between the inferior margin of the ribs and the superior surface of the pelvis in the midaxillary line.
- A rib-pelvis distance of ≤ 2 fingerbreadths does not confirm a fracture, but indicates further evaluation is appropriate (thoracic and lumbar radiographs).
- > 2 fingerbreadths, rule out lumbar compression fracture with a high degree of certainty.
- ≤1 fingerbreadth, rule in fracture with high certainty.

(Siminoski K et al, 2003)

BALANCE TEST & MEASURE
Balance Test: BRIEF-BESTest
(Brief-Balance Evaluation Systems Test)

Brief-BESTest Purpose

• To assess balance in way that helps identify the underlying postural control systems responsible for poor functional balance
• To differentiate individuals with and without diagnosed neurologic disorders and sensitivity to falls

Brief-BESTest Procedures

- Brief-BESTest items are:
  - Hip abductor strength
  - Functional reach
  - One-leg stance
  - Lateral push-and-release
  - Standing on foam with eyes closed
  - Timed “Up & Go” Test

(Padgett PK, et al, 2012)

Brief-BESTest Procedures

- BIOMECHANICAL SYSTEM
  - Functional ankle and hip strength (force generating capacity)
    - Lightly rest individual’s fingertips in PT’s hands while lift leg out to side with foot off floor with a straight knee
    - Try to keep trunk vertical while holding leg out
    - Hold until told to stop (10 seconds)
    - If use moderate force on PT’s hands to keep their trunk upright, score as without keeping trunk vertical
**Brief-BESTest Procedures**

- **LIMITS OF STABILITY/VERTICALITY**
  - Functional limits of stability of stability
    - Ability in standing to reach maximally forward (over 32 cm/12.5 inches)
    - Stand normally, lift both arms straight in front, with fingertips held even, stretch fingers and reach forward as far as can
    - Don’t lift heels
    - Don’t touch ruler or wall
    - Once reached as far forward as can, return to normal standing position
    - Do it 2x

- **ANTICIPATORY POSTURAL ADJUSTMENT**
  - Stand on one leg
    - Look straight ahead
    - Keep hands on hips
    - Bend one leg behind
    - Don’t touch raised leg on other leg
    - Stay standing on one leg as long as can (30 seconds)
    - Look straight ahead
    - Stop if moves hands off hips or puts foot down
    - Repeat other side
Brief-BESTest Procedures

• SENSORY ORIENTATION
  – Sensory integration for balance
    • Standing on foam or on normal ground
    • Hands on hips and feet together until almost touching
    • Look straight ahead
    • Close eyes
    • Stay as stable as possible until you indicate should stop (30 seconds)

Brief-BESTest Procedures

• STABILITY IN GAIT
  – Timed “Get Up and Go”
    • Firm chair with arms to push from if necessary
    • Individual sits with back against chair
    • Time from time you say “go” until returns to sitting in chair
    • Walk at normal speed across tape on floor, turn, and come back to sitting
    • Stop timing when the buttocks hit chair bottom
Brief-BESTest Procedures

• Scoring
  Section I: Biomechanical Constraints
  ________/3 x 100 = _______
  Section II: Stability Limits/Verticality
  ________/3 x 100 = _______
  Section III: Transitions/Anticipatory
  ________/6 x 100 = _______
  Section IV: Reactive
  ________/6 x 100 = _______
  Section V: Sensory Orientation
  ________/3 x 100 = _______
  Section VI: Stability in Gait
  ________/3 x 100 = _______
  TOTAL: ________/24 points = _______% Total Score

Brief-BESTest Norms
(O’Hoski, S, et al, 2014)

<table>
<thead>
<tr>
<th>Test</th>
<th>50-59 yrs</th>
<th>60-69 yrs</th>
<th>70-79 yrs</th>
<th>80-89 yrs</th>
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<tbody>
<tr>
<td>Total score (%)</td>
<td>22.7</td>
<td>20.5</td>
<td>18.8</td>
<td>15.0</td>
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<tr>
<td>(max score = 24)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section score (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomechanical</td>
<td>2.9</td>
<td>2.1</td>
<td>2.2</td>
<td>1.8</td>
</tr>
<tr>
<td>constraints</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stability limits/</td>
<td>2.7</td>
<td>2.5</td>
<td>2.4</td>
<td>2.0</td>
</tr>
<tr>
<td>verticality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipatory postural</td>
<td>5.7</td>
<td>5.6</td>
<td>4.0</td>
<td>2.6</td>
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<tr>
<td>adjustments</td>
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</tr>
<tr>
<td>Postural responses</td>
<td>5.7</td>
<td>4.9</td>
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<tr>
<td>Sensory orientation</td>
<td>2.8</td>
<td>2.6</td>
<td>2.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Stability in gait</td>
<td>3.0</td>
<td>3.0</td>
<td>2.9</td>
<td>2.6</td>
</tr>
</tbody>
</table>
GAIT & MOBILITY
TESTS AND MEASURES

• Gait Speed
• Tandem Gait Test

GAIT SPEED
TANDEM GAIT TEST

Tandem Gait Test

- Line 6 meters long and 5 centimeters wide
- Check that able to see the line
- Steps counted once person places one foot before the other and stopped
  - once a foot touched the floor before proper placement
  - the heel didn’t touch the toes
  - the foot wasn’t on the line
  - 20 steps was reached
- The unsuccessful step is not counted in the score
- Should be able to complete 20 steps
- Best performance of a maximum of 3 trials used

(Vereeck L, et al. 2008)
**Tandem Gait Test Norms**
*(max 20 steps: best of 3 trials)*

<table>
<thead>
<tr>
<th>Age range</th>
<th>Steps Mean</th>
<th>SD</th>
<th>Median</th>
<th>CI (5-95%)</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>20-29</td>
<td>20</td>
<td></td>
<td></td>
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<tr>
<td>30-39</td>
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<tr>
<td>40-49</td>
<td>20</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>50-59</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>60-69</td>
<td>17.2</td>
<td>5.7</td>
<td>20</td>
<td>4-20</td>
<td>2-20</td>
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<tr>
<td>70-79</td>
<td>14.1</td>
<td>7.0</td>
<td>20</td>
<td>2-20</td>
<td>1-20</td>
</tr>
</tbody>
</table>

(Verreck L, et al. 2008)

**AEROBIC CAPACITY/ ENDURANCE TEST**

- 2-minute Step Test
  - Normative data for men and women, 60-94 yrs of age
MUSCLE PERFORMANCE

• Grip Strength
  – Upper extremity
• Chair Rise Test
  – Lower extremity
• Biering Sorenson Test
  – Back extensors

OSTEOPOROSIS EXERCISE

Exercise to Increase/Maintain Bone Density
Posture and Body Mechanics
Balance Exercises
Exercise Recommendations for Osteoporosis

• Regular weight-bearing and muscle strengthening exercise
  – Maintain or improve bone strength
  – Agility, strength, posture, and balance
  – Reduce risk of falls and fractures
• Assess risk factors for falls; modifications (e.g., home safety assessment, balance training exercises, correction of vitamin D insufficiency, avoidance of central nervous system depressant medications, careful monitoring of antihypertensive medication, and visual correction when needed)


PRESCRIBING EXERCISE

Aerobic Conditioning/Endurance Training
Strength/Resistance Training
Balance Training
Body Mechanics and Postural Stabilization
Exercise Prescription

• Exercise prescription includes:
  – Frequency
  – Intensity
  – Time
  – Type
• Warm-up/cool down
• Prescribing exercise
  – Overload principle
  – Specificity of exercise
  – Consider pain status
  – Explosive movements contraindicated with osteoporosis

ACSM Guidelines People Who are at Risk for Osteoporosis
(ACSM 8th ed, 2010)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>GUIDELINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Weight-bearing aerobic 3-5 days/wk and resistance 2-3 day/wk</td>
</tr>
<tr>
<td>Intensity</td>
<td>Mod (60-80% 1-RM, 8-12 reps resistance) to high (80-90%, 5-6 reps for resistance)</td>
</tr>
<tr>
<td>Time</td>
<td>30-60 min/day of a combination of weight-bearing aerobic and resistance</td>
</tr>
<tr>
<td>Type</td>
<td>Weight-bearing aerobic, activities that involve jumping, and resistance exercises</td>
</tr>
</tbody>
</table>
## ACSM Guidelines People with Osteoporosis

*(ACSM 8th ed, 2010)*

<table>
<thead>
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</tr>
<tr>
<td>Intensity</td>
<td>Mod (40 to &lt;60% VO$_2$R or HRR) for WB aerobic and mod (60-80% 1-RM, 8-12 reps) for resistance exercise in terms of bone-loading forces, although some individuals may be able to tolerate more</td>
</tr>
<tr>
<td>Time</td>
<td>30-60 min/day of a combination of weight-bearing aerobic and resistance</td>
</tr>
<tr>
<td>Type</td>
<td>Weight-bearing aerobic, activities and resistance exercises</td>
</tr>
</tbody>
</table>

## Exercise to Increase/Maintain Bone Density

- Examples of high-impact weight-bearing exercises
  - Dancing
  - High-impact aerobics
  - Hiking
  - Jogging/running
  - Jumping Rope
  - Stair climbing
  - Tennis

Exercise to Increase/Maintain Bone Density

- Low-impact weight-bearing exercises; safe alternative
  - Elliptical
  - Low-impact aerobics
  - Stair-step machines
  - Fast walking on a treadmill or outside


Exercise to Increase/Maintain Bone Density

- CIRCUIT TRAINING
  - A regular walking, or jogging program (outdoors or indoors) may also be enhanced and made more enjoyable by breaking up the continuous activity with stations of alternative activities
  - Activities may include:
    1. Toe raises
    2. Sit to stand
    3. Push-ups/plank
    4. Heel raises
    5. Standing balance
    6. Agility around posts
    7. Quadriceps, hamstrings and calf stretches
Balance Training

- FREQUENCY
  - 5-7 days/week
  - Older adults preferable daily
Balance Training

• INTENSITY
  • Balance is a motor skill
  • Must challenge limits of stability both statically and dynamically
  • Use variety of progressive activities targeting important postural muscle groups

Balance Training

• TIME
  • May be done either as
    • Specified balance exercise session (10-15 minutes)
    • Incorporated into daily activities (e.g., balance on toes while brushing teeth, walk the hallway one time on toes, one time on heels, one time tandem, crossovers, grapevines, head movements)
Balance Training

- TYPE
  - Static Balance and Dynamic Balance
    - Two-leg and one-leg stance, eyes open and eyes closed
    - Side stepping
    - Walk on toes, heels
    - Tandem walk
    - Carioca
    - Ball exercises
    - Balance, wobble boards

Balance Training

- TYPE
  - Foam surfaces
  - Stability/Swiss balls
  - Foam rollers
  - Core Balance Trainer/Dyna discs
  - Trampolines
  - Tai Chi
  - BOSU (Both Sides Up)
Body Mechanics and Postural Stabilization

POSTURAL CHANGES OF OP:
- Forward head / protracted cervical spine
- Rounded shoulders
- Kyphoscoliosis or hyperkyphosis
- Flattened or increased lumbar lordosis
- Flexed or extended hips
- Flexes knees
Body Mechanics and Postural Stabilization

- **FREQUENCY, INTENSITY, TIME, TYPE**
  - Done as a posture exercise program
  - Incorporated into aerobic capacity/endurance training, balance and agility training, strength training

Body Mechanics and Postural Stabilization

- **Focus on:**
  - Stretching: pectorals, cervical and thoracic spine, hip flexors, knees
  - Strengthening: abdominals, spine extensors, scapular stabilizers, buttocks, lower extremities
- Individualized by PT examination
Body Mechanics and Postural Stabilization

- Place into position of comfort
- Realize altered position due to postural changes when prescribing exercises and monitor substitutions
- Foam rolls, ball exercises, exercise bands, Pilates/yoga with precautions
- Posture bras, taping bras, and bracing

Kyphotic Posture Program
(Katzman WB, Sellmeyer DE, Stewart AL, et al. 2007)

<table>
<thead>
<tr>
<th>EXERCISE</th>
<th>INTENSITY/DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-up (5 min)</td>
<td>Active ROM 10 reps</td>
</tr>
<tr>
<td>ROM shoulders, chest, upper back</td>
<td></td>
</tr>
<tr>
<td>Strengthening</td>
<td>3 sets 8 reps, 0-5 lbs or elastic band</td>
</tr>
<tr>
<td>a) Prone trunk lifts to neutral</td>
<td>a) Arms “W” position</td>
</tr>
<tr>
<td>b) Quadruped arm/leg lift</td>
<td>b) Cuff weights – ankle/wrist</td>
</tr>
<tr>
<td>c) Supine shoulder flex on roller</td>
<td>c) Elastic band</td>
</tr>
<tr>
<td>d) Side-lying thoracic extension</td>
<td>d) Elastic band</td>
</tr>
<tr>
<td>ROM (15 min)</td>
<td></td>
</tr>
<tr>
<td>a) Supine on roller - chest stretching</td>
<td>30 sec hold &amp; diaphragmatic breathing</td>
</tr>
<tr>
<td>b) Prone hip ext</td>
<td>a) Combine with shoulder flexion</td>
</tr>
<tr>
<td>c) Supine SLR</td>
<td>b) Stretch strap</td>
</tr>
<tr>
<td>d) Quadruped chest stretch and thoracic extension</td>
<td>c) Stretch strap</td>
</tr>
<tr>
<td></td>
<td>d) Passive</td>
</tr>
</tbody>
</table>
**Kyphotic Posture Program**  
(Katzman WB, Sellmeyer DE, Stewart AL, et al. 2007)

<table>
<thead>
<tr>
<th>EXERCISE</th>
<th>INTENSITY/DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postural alignment (15 min)</td>
<td></td>
</tr>
<tr>
<td>a) Postural correction</td>
<td>Active</td>
</tr>
<tr>
<td>b) Sit to stand with neutral spine</td>
<td>a) Standing, eyes open, closed</td>
</tr>
<tr>
<td></td>
<td>b) On ball (10 reps)</td>
</tr>
<tr>
<td>Cool-down (5 min)</td>
<td></td>
</tr>
<tr>
<td>a) Wall push-up</td>
<td>Active</td>
</tr>
<tr>
<td>b) Overhead arm wall slides</td>
<td>a) Body weight resistance – 10x</td>
</tr>
<tr>
<td>c) Calf stretching</td>
<td>b) Lift arms from wall at end of range – 10x</td>
</tr>
<tr>
<td>Home postural program</td>
<td>c) 30 sec hold – 1x each leg</td>
</tr>
<tr>
<td></td>
<td>3x/day</td>
</tr>
</tbody>
</table>

**Extension Exercises**

(Ball JM, Cagle P, Johnson BE, Lucasey C, Lukert BP. 2009)
Precautions for People at Risk of Osteoporotic Fracture

- Avoid high-impact loading, exercises that involve twisting, bending, or compression of the spine (ACSM 8th ed, 2010)
- Flexion of the spine causes compression on the anterior vertebral bodies risk of vertebral fracture

Core Strengthening

**BODY MECHANICS & POSTURAL STABILIZATION**

- Abdominal strengthening without flexion - EMG comparison of deep and rectus muscles using crunch as reference (Olson M, 2013)

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Deep Muscles %</th>
<th>Rectus Abdominis %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard crunch</td>
<td>100 (reference value)</td>
<td>100</td>
</tr>
<tr>
<td>Hip extensions on ball</td>
<td>111</td>
<td>100</td>
</tr>
<tr>
<td>Bird dog (quadruped)</td>
<td>113</td>
<td>80</td>
</tr>
<tr>
<td>Dynamic side bridge</td>
<td>128</td>
<td>79</td>
</tr>
<tr>
<td>Isometric side bridge (plank)</td>
<td>122</td>
<td>59</td>
</tr>
</tbody>
</table>
Core Strengthening

BODY MECHANICS & POSTURAL STABILIZATION

- Abdominal strengthening without flexion – EMG rank of superficial abdominal muscle activity (Olson M, 2013)

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Rectus Abdominis %</th>
<th>External Obliques %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard crunch</td>
<td>100 (reference value)</td>
<td>100</td>
</tr>
<tr>
<td>Yoga dolphin plank on ball</td>
<td>105</td>
<td>147</td>
</tr>
<tr>
<td>Yoga side plank</td>
<td>105</td>
<td>139</td>
</tr>
</tbody>
</table>
MEDICATION, LIFESTYLE, AND NUTRITIONAL CONSIDERATIONS

Medications for Osteoporosis

- Range of drug treatments available for postmenopausal osteoporosis
- Treatment ↓ the risk of vertebral fracture 30-65% and non-vertebral fracture 16-70%
- Poor compliance by patients with drug therapies for osteoporosis over a year leaves them at risk for fractures and higher healthcare costs (IOF, 2011)
Medications for Osteoporosis

- Calcium and vitamin D
- Bisphosphonates: alendronate, ibandronate, risedronate, zoledronic acid
- Calcitonin
- Denosumab
- Estrogen
- SERMS: raloxifene
- PTH: teraparatide
- RANK ligand (RANKL) inhibitor: denosumab
  (http://www.nof.org/aboutosteoporosis/managingandtreating/medicinesneedtoknow)

Nutritional Considerations: Osteoporosis

- Total calcium intake
  - Men 50–70: 1000 mg/day
  - Women ≥ 51 and men ≥ 71 yrs: 1200 mg/day, supplement if needed
- Vitamin D
  - ≥ 50 yrs: 800–1000 IU/day, supplement if needed
Smoking and Alcohol Intake: Universal Recommendations

Cessation of tobacco smoking
• Cigarette smoking is a risk for OP and delays fracture healing

Limit alcohol intake
• Standard healthy guidelines apply
  – 2 servings/day for men
  – 1 serving/day for women


OSTEOPOROSIS IN YOUR PRACTICE

From Bare Bones To Big Business
1) Highlight osteoporosis management in your practice
2) Having osteoporosis be a focus of your programming
3) Build this as a key component of your practice
RESOURCES

National Osteoporosis Foundation
https://www.nof.org/
International Osteoporosis Foundation
https://www.iofbonehealth.org/
Osteoporosis Canada
http://www.osteoporosis.ca/
Centers for Disease Control and Prevention
http://www.cdc.gov/homeandrecreationalsafty/falls/

MARKETING STRATEGIES: REFERRALS

- Endocrinologist
- Gynecologist
- Rheumatologist
- Internal medicine
- Gerontologist
- Orthopedist
- Nurse Practitioner
- Physician Assistant
- Physical and Occupational Therapists
- Social worker
- Psychologist
- Community agencies
- Health Fair
- Community Screening
- Self-referral
OSTEOPOROSIS IN YOUR PRACTICE

1) Highlight osteoporosis management in your practice

SPACE, EQUIPMENT, AND PERSONNEL NEEDS

• No change in space or personnel from traditional practice
• Stadiometer ($150)
• Mats (<$10)
• Half foam rolls - 36” ($10)
• Balls – 55-65 cm ($10)
• Exercise bands (<$10)
• Stretch straps/gait belt (<$10)
• Dowels for balance support – 1” x 48” (2 @$5 each)
• Balance equipment/props
OSTEOPOROSIS IN YOUR PRACTICE

2) Having osteoporosis be a focus of your programming

SPACE, EQUIPMENT, AND PERSONNEL NEEDS

- No change in space from traditional practice
- Possible addition of personnel with knowledge/interest in osteoporosis/geriatrics
- Funding for continuing education (NOF, Bone Fit™)
- Increase outreach to community (time and screening equipment)
- Stadiometer-possibly portable ($100-$150)
- Equipment from Tier 1 plan
OSTEOPOROSIS IN YOUR PRACTICE

3) Build this as a key component of your practice

Bonny O’Hare, Physiotherapist
Thornhill, Ontario

TheraPilates
Sherri Betz
PT, GCS, CEEAA, PMA®-CPT
Santa Cruz, CA

SPACE AND PERSONNEL NEEDS

• Consider use of large open area for group classes
• Possible addition of exercise class leader with knowledge/interest in geriatrics, osteoporosis, and balance/fall prevention
• Funding for education in safe and effective exercise for osteoporosis (Bone Fit™)
  – Charge for classes to increase income
• Increase outreach to community (time and screening equipment)
SPACE AND EQUIPMENT NEEDS

• Instructor in the front
  – Space for exercise: 6 x 6 ft
  – Space to walk/monitor/cue: 2 ft
  – Per person: 8 x 8 ft

• Equipment storage
  – Mats
  – Chairs
  – Foam rollers
  – Ball racks
  – Weight racks
  – Balance equipment bins

SPACE AND EQUIPMENT NEEDS

• Stadiometer ($150)
• Mats (bring own or <$10)
• Chairs ($20)
• Half foam rolls - 36” ($10)
• Balls – 55-65 cm ($10)
• Exercise bands (<$10)
• Stretch straps (<$10)
• Dowels for balance support – 1” x 48” (2 @ $5 each)

• AirEx® pads ($60)
• Theraband® Stability Trainers and Discs ($25-$35 each)
• BOSU® Balance Trainer ($80-$100)
• Rockers, wobble boards