


# Osteoporosis Prevention

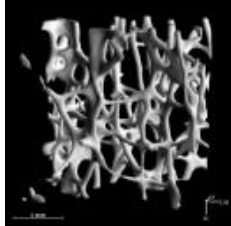


## Osteoporosis Prevention

Don Hall, DrPH, CHES  
Wellspring Institute for Healthy Living  
*The Prevention Series*

## Introduction

The problem



2 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## Osteoporosis is...

- A disease that gradually weakens bones and often leads to painful, debilitating fractures
- A major health threat for 29 million Americans
  - 10 million have osteoporosis
  - 19 million have low bone mass
- Occurs mostly in women (80%)
- One out of 5 hip fractures will be in men
- Causes 1.5 million fractures annually
- Costs this country \$14 billion each year

Source: National Osteoporosis Foundation

3 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## Hip Fractures

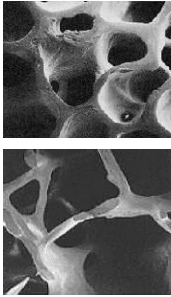
- Hip fractures result in 300,000 hospital admissions each year in the U.S.
- This results in an estimated \$9 billion in direct medical expenses

Source: CDC&P Hanes III Data, JAMA, Jan. 20, 1999

4 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## Osteoporosis

- Normal, healthy bone structure
- Osteoporotic bone, weak, high risk of fracture



Photos from National Osteoporosis Foundation

5 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## Increase Awareness of Osteoporosis

- In one group of 2,314 post menopausal women diagnosed with osteoporosis, 93% were not aware they had any problem.
- Awareness and prevention must be the focus to address this problem.

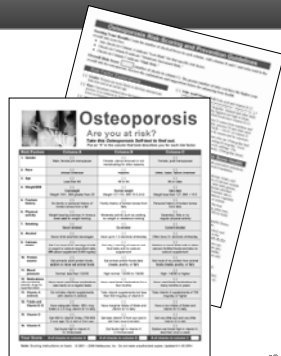
Source: CDC, NHANES III

6 © 2005 - 2006 Wellspring, Inc. All rights reserved.

# Osteoporosis Prevention

## The Causes

- Age
- Body size
- Risk factors
- Self-test



7 © 2005 - 2006 Wellsource, Inc. All rights reserved.

## Three Fundamental Requirements for Bone Health

- Good nutrition
  - Adequate calcium, vitamin D, vitamin K, protein
- Adequate hormones such as:
  - Men: testosterone
  - Women: estrogen
- Weight-bearing activity
  - Stimulates calcium absorption and deposition in bones

8 © 2005 - 2006 Wellsource, Inc. All rights reserved.

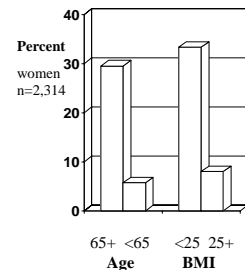
## Bone Remodeling

- Osteoclasts remove bone
- Osteoblasts replace bone
- Remodeling goes on continually
  - If bones have the right nutrients and stimulus from physical activity, they stay strong and healthy
  - A negative balance in remodeling results in osteoporosis

9 © 2005 - 2006 Wellsource, Inc. All rights reserved.

## Age and Prevalence of Osteoporosis

- Osteoporosis among 2,314 women, post menopause or ovaries removed, and not taking estrogen
- Age differences
  - Women 65+, 29.5%
  - Women <65, 5.7%
- Body weight differences
  - Lean, BMI <25, 33.3%
  - BMI 25 or higher, 8.0%

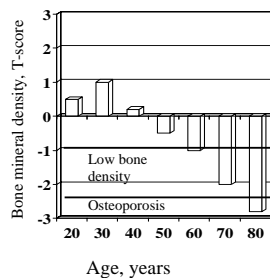


Source: CDC, NHANES III

10 © 2005 - 2006 Wellsource, Inc. All rights reserved.

## Bone Density Test

- Measures bone density in terms of young, health persons.
- Measured in terms of a "T-Score"
  - 1 means 10-12% below average for a young healthy person or "low bone mass"
  - 2.5 means 20-30% below average for a young, healthy person or "osteoporosis"



11 © 2005 - 2006 Wellsource, Inc. All rights reserved.

## Screening Guidelines

- The US Preventive Services Task Force recommends doctors routinely screen all women over 65 for osteoporosis
  - starting at younger ages if at increased risk
  - bone densitometry (also known as DEXA, dual-energy x-ray densitometry) is a widely accepted and widely used method for measuring bone density

Source Annals of Internal Medicine 17th September 2002

12 © 2005 - 2006 Wellsource, Inc. All rights reserved.

# Osteoporosis Prevention

## Osteoporosis Risk Factors

- Personal history of a fracture as an adult
- Caucasian (white)
- Older age
- Caucasian or Asian post-menopausal women
- Small frame, BMI < 25, weight less than 154 lbs.
- Smoking
- Low calcium intake (over a lifetime)
- Estrogen deficient (post menopause, ovaries removed, or amenorrhea over 1 yr)
- Physically inactive
- High alcohol intake
- Prolonged exposure to certain medications such as steroids or an anticonvulsant
- High salt or caffeine intake

13 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## Preventive Actions

### Guidelines for Strong Bones



14 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## WHO Guidelines for Healthy Bones

1. Increase physical activity
  - weight bearing, strengthening, and vigorous activities are most beneficial
2. Get adequate calcium and vitamin D
  - especially in young girls
  - 2-3 servings of high calcium foods/day
3. Reduce sodium intake
4. Increase consumption of fruits and vegetables, especially leafy greens



World Health Organization, Diet, Nutrition, and the Prevention of Chronic Disease, Geneva, 2003

15 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## WHO Guidelines for Healthy Bones

5. Maintain a healthy body weight
  - not too lean or too fat
6. Avoid smoking
7. Avoid or limit alcohol intake
  - high intakes of alcohol lower bone calcium levels and increase the risk of a fall and fractures
8. Avoid high intakes of vitamin A (retinol)
  - high levels increase risk of fracture

World Health Organization, Diet, Nutrition, and the Prevention of Chronic Disease, Geneva, 2003, and Women's Health Study, Harvard University

16 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## Avoid Taking Excess Vitamin A

- Getting high levels of vitamin A (retinol) from food and supplements can have a negative effect on bone health and increase risk of fractures
- In the Nurse's Health Study, those women in the top 20% of vitamin A (retinol) intake had a 48% increased risk of hip fracture compared to women in the bottom 20%
- Vitamin A from beta-carotene is not linked to increased risk of hip fractures

Nurses Health Study, JAMA Jan. 2, 2002, 287:47-54

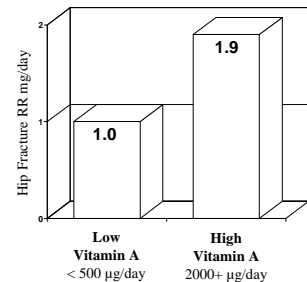
17 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## High Vitamin A Intake and Hip Fractures

A high intake of vitamin A (retinol) nearly doubled the risk of hip fractures

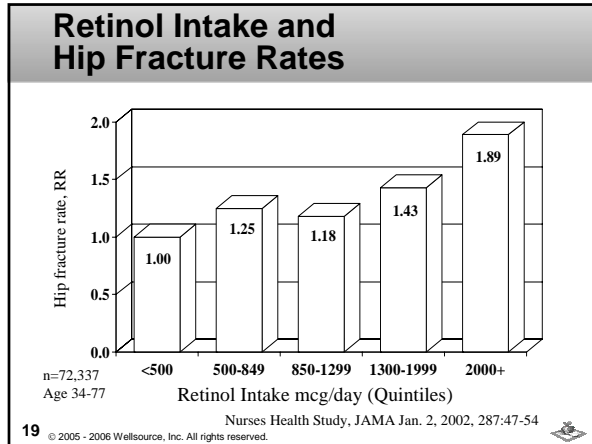
n=72,337 post-menopausal women age 34-77 years followed 18 years

JAMA Jan 2, 2002



18 © 2005 - 2006 Wellspring, Inc. All rights reserved.

# Osteoporosis Prevention



- ### Recommended Intake of Vitamin A
- The recommended dietary allowance for vitamin A is 700 mcg/day for women, 900 mcg/day for men.
  - The tolerable upper limit is 3000 mcg/day.
    - 21% of women were above this figure due to taking supplements and vitamin A added to foods (milk, margarine, breakfast cereals, etc.)
    - For every 500 mcg/day increase in retinol, hip fractures increased by 15-33%
- 20 © 2005 - 2006 Wellspring, Inc. All rights reserved.

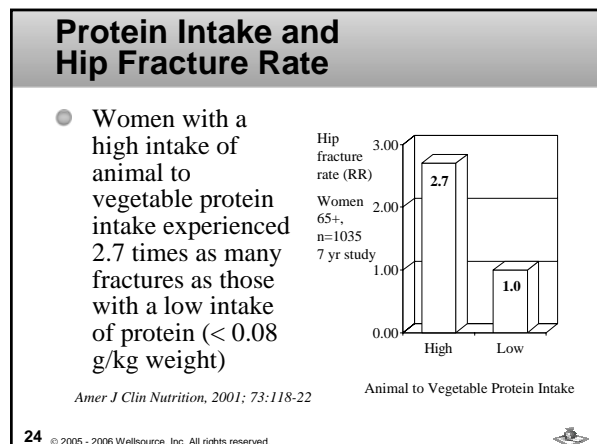
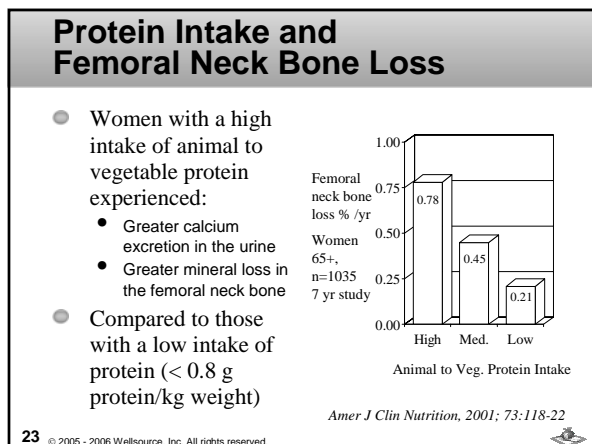
### Preventive Actions

**Nutrition**

- Protein
- Calcium
- Vitamin D
- Vitamin K
- Vitamin B-12

21 © 2005 - 2006 Wellspring, Inc. All rights reserved.

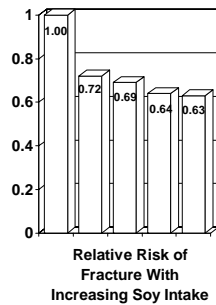
- ### Get Sufficient Protein
- Adequate protein is essential for bone health
    - Studies show in the elderly that those who get more protein have lower fracture rates
  - Vegetable protein is preferable to animal protein for bone health
    - Vegetable protein lowers calcium loss compared to animal protein
- 22 © 2005 - 2006 Wellspring, Inc. All rights reserved.



# Osteoporosis Prevention

## Soy and Risk of Bone Fracture

- Among 24,403 Chinese women aged 40 to 70 years, higher soy food intakes were increasingly protective against risk of fracture.
- For women within 10 years of menopause, risk was 48% lower between extreme quintiles of soy intake.



Zhang, X, et al. Arch Intern Med 2005;165:1890-1895

25 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## Get Adequate Calcium

- It doesn't matter where the calcium comes from as long as you get enough
  - Milk, yogurt, other dairy products
  - Calcium supplement (taken with meals)
  - Fortified foods (soy milk, orange juice, V8-Juice)
  - High calcium foods
    - Greens, tofu, sesame seed

26 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## Calcium RDAs

Life stage	mg/day
Teens	1300
Adults 20-50	1000
Adults 50 or older	1200



Source:  
National Academy of Sciences  
Food and Nutrition Board, 1997 (latest values)

27 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## Eat at least Two Servings of Calcium Rich (250+mg) Foods Daily

Food	Calcium mg	Food	Calcium mg
Milk, 2%	285	Soymilk:	
Skim milk, 1 C	290	Not fortified, 1C	93
Yogurt, fruit, 8 oz	313	Fortified, 1C	250-360
Mozzarella cheese, part skim 1 oz	222	Baked beans, 1C	86
Orange J. with Ca	300	Orange, 1 med.	38
V-8 juice with Ca	300	Turnip greens, 1/2 C	99
Tofu:		Cot. Cheese, 1/2 C	63
Firm, 1/2 cup	253	Broccoli, fresh 1C	62
Soft, 1 slice	26	Tortilla, 2	195

28 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## Get Adequate Vitamin D

- Vitamin D is essential for absorbing calcium and for depositing calcium in bones. This helps:
  - increase bone strength, and
  - decrease bone loss.
- Sunshine, an hour per day, or
- Vitamin D 400-800 I.U. daily
  - Persons over 70 may need 800 IU a day as they don't absorb it as well
  - Low vitamin D levels in elderly is common

29 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

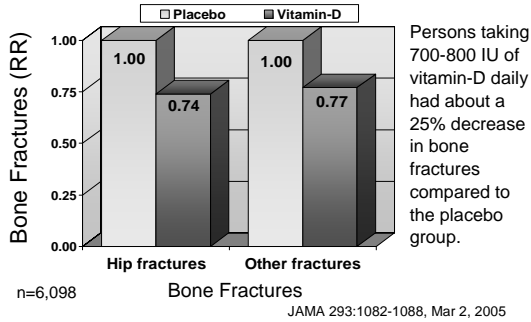
## How Vitamin D Helps Prevent Fractures

- Vitamin D helps increase bone strength and decrease bone loss.
- Vitamin D appears to have a beneficial effect on muscle strength and balance.
  - One study showed a 22% decrease in falls in elderly individuals taking vitamin D supplements.
  - Another review of several studies showed that vitamin D reduced falls by 35%.

30 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

# Osteoporosis Prevention

## Vitamin-D and Risk of Fractures



31 © 2005 - 2006 Wellsolve, Inc. All rights reserved.

## Author's Conclusions

- "Oral vitamin D supplementation in the range of 700-800 IU/day should reduce the risk of hip or non-vertebral fractures by approximately 25%."
- Oral vitamin D supplements of only 400 IU/day did **not** show any decrease in fracture in this study of elderly people.

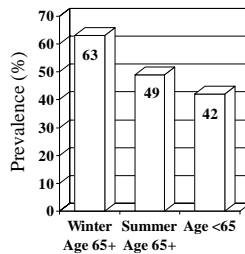


JAMA 293:2257-64, May 11, 2005

32 © 2005 - 2006 Wellsolve, Inc. All rights reserved.

## How prevalent are low vitamin D levels?

- 290 consecutive patients on a general medical ward in Massachusetts
- Prevalence of low Vitamin D
  - 63% in March (Winter)
  - 49% in September (Summer)
  - 42% in a subgroup less than age 65 with no chronic disease



Groups of People  
Northern region with low sunlight in winter

NEJM 338:777-83, Mar. 19, 1998

33 © 2005 - 2006 Wellsolve, Inc. All rights reserved.

## Get Adequate Vitamin K from the Diet

- In the Nurse's health study, those who ate the most vitamin K (250 micrograms/day) had half the bone fractures as those who ate the least (60/day)
- The Framingham study also showed a link between vitamin K and bone mineral density
- Vitamin K is in dark green, leafy vegetables
  - Kale, Romaine lettuce, Spinach, Collards, etc.

34 © 2005 - 2006 Wellsolve, Inc. All rights reserved.

## Vitamin K in Foods

Food	Vitamin K micrograms
Spinach, ½ C ckd	444
Collards, ½ C ckd	418
Brussel sprouts ½ C	109
Coleslaw 1 C	75
Broccoli, 1 5" spear	52
Romaine lettuce ½ C	48
Iceberg lettuce, 1C	17

Recommended intake:

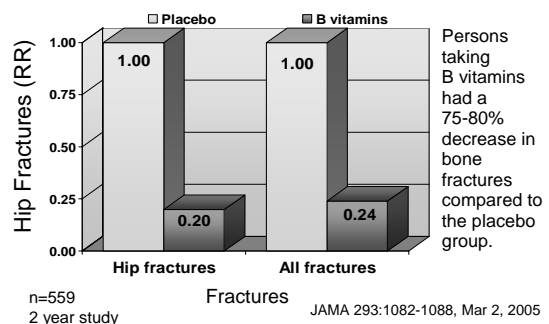
Men - 120 mcg/day  
Women - 90 mcg/day

250 mcg/day showed lowest fracture rates

Source: USDA Nutrient Database and the National Academy of Sciences

35 © 2005 - 2006 Wellsolve, Inc. All rights reserved.

## Vitamin B-12 and Risk of Hip Fx



36 © 2005 - 2006 Wellsolve, Inc. All rights reserved.

# Osteoporosis Prevention

## Author's Conclusions

“In conclusion, combined treatment in our population with folate and vitamin B<sub>12</sub> is safe and effective in reducing the risk of a hip fracture in elderly patients of both sexes following stroke.”



JAMA 293:1082-1088, Mar 2, 2005

37 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## Preventive Actions

### Exercise

- Age
- Gender
- Weight-bearing



38 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## Increase Physical Activity

- In young children and teens to build strong, healthy bones (most important years)
- In older persons to slow loss of bone mineral content and to improve strength, balance, and agility (helps prevent falls)

39 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## Physical Activity and Bone Health

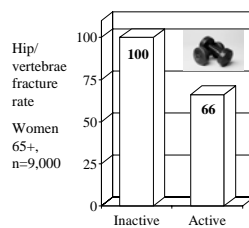
- Physical activity is necessary for bone acquisition and maintenance through adulthood
  - Exercise stimulates the bone to increase/maintain calcium levels and strength
  - Exercise enhances calcium absorption from the diet
  - Exercise maintains strength, balance, and coordination, thus decreasing falls and fractures
  - Exercise is most beneficial in youth and early adulthood in increasing peak bone mineral mass

JAMA, Feb. 14, 2001

40 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## Physical Activity and Fractures

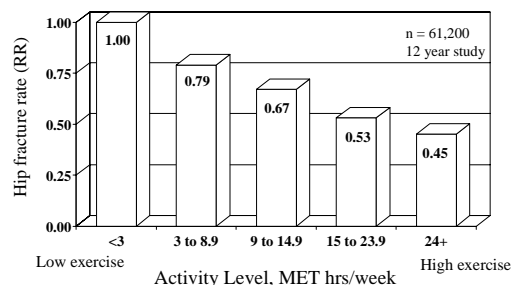
- Women who did aerobic exercise regularly:
  - played tennis 2 hr weekly
  - went walking regularly
  - did gardening
  - lifted weights
  - went social dancing
- Cut their risk of hip and vertebral fracture by one-third compared to inactive women.



Annals of Internal Medicine, July 15, '98

41 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

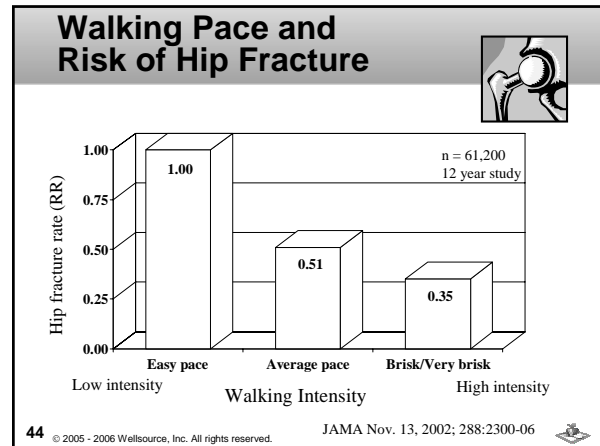
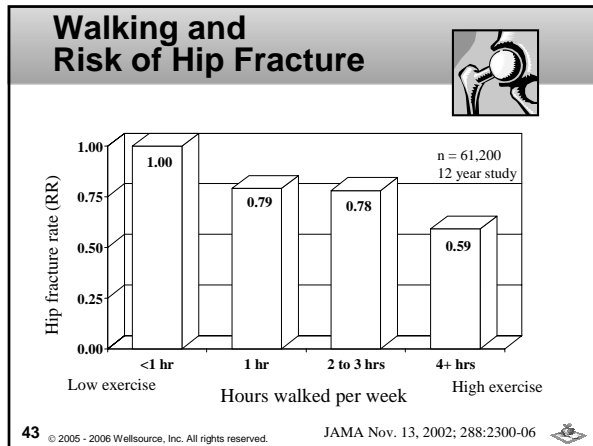
## Physical Activity and Risk of Hip Fracture



JAMA Nov. 13, 2002; 288:2300-06

42 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

# Osteoporosis Prevention



## Strong Muscles Help Prevent Falls

“Clinical trials of exercise have been shown to reduce the risk of falls by approximately 25%.”

JAMA, Feb. 14, 2001

45 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## Best Exercises for Bone Health

- Weight bearing exercises
- Exercises that put a stress on the bones (overload principle)
  - Jogging
  - Skipping rope
  - Tennis, basketball
  - Weight lifting
- Consistent exercise for a lifetime

JAMA, Feb. 14, 2001

46 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## Prevent Falls

The most effective ways to prevent fractures is to prevent falls

- Wear sturdy, low heeled, soft-soled shoes
- Secure all rugs. Avoid throw rugs.
- Keep halls and stairs well lighted
- Add grab bars and nonskid surfaces to showers and tub
- Keep up muscle strength and agility with exercise

47 © 2005 - 2006 Wellspring, Inc. All rights reserved.

## Preventive Actions

Other factors

48 © 2005 - 2006 Wellspring, Inc. All rights reserved.

# Osteoporosis Prevention

## Avoid Excess ...

- Caffeine
- Salt (sodium)
- Smoking
- Alcohol

These substances all increase bone loss

49 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## High Alcohol Intake Harms Bone Health By...

- Altering hormone levels (PTH, cortisol, and sex hormones) resulting in bone loss
- Inhibiting body's ability to form vitamin D necessary for bone formation
- Creating a direct toxic effect on osteoblasts, suppressing bone formation
- Increasing risk of falls and fractures

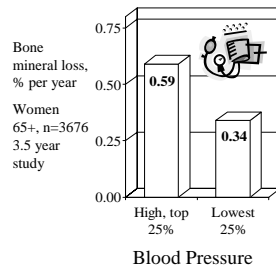
NIH, Osteoporosis Resource Center

50 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## High Blood Pressure and Bone-Mineral Loss

In a study of women, age 65+, higher blood pressure was associated with increased bone loss at the femoral neck, increasing risk for hip fracture.

*Lancet* 1999; 354:971-75



51 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

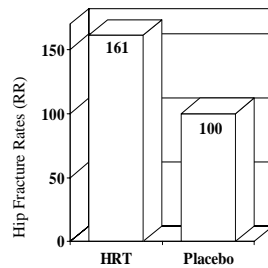
## Medications

- If indicated (from a bone scan) that you need additional help, medications can help
- Biphosphonates (discuss with your doctor)
  - Alendronate (Fosamax) – reduced vertebral & hip fractures by 50%
  - Raloxifene (Evista)– reduced vertebral fractures by 30% but not hip fractures
  - Risedronate – reduced fracture rates by 50-65%
- Estrogen (HRT)
  - Latest research shows that HRT is not recommended for reducing fractures in older women
  - Other safer alternatives are available

52 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## HRT and Fracture Rates

- Clinical trial, 6.8 years
- Took HRT or placebo
- 2763 post menopausal women (HERS study)
- After 6.8 years of HRT treatment, hip fracture rates were higher than those taking a placebo



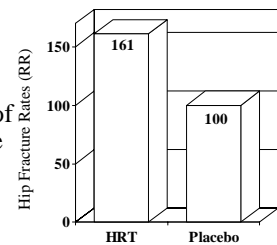
JAMA 288:58-66, July 3, 2002

53 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

## HRT and Fracture Rates

Conclusion:

“We did not observe any reduction in risk of all fractures in the hormone group”



JAMA 288:58-66, July 3, 2002

54 © 2005 - 2006 Wellsorce, Inc. All rights reserved.

# Osteoporosis Prevention

## Summary -- Actions You Can Take to Prevent Osteoporosis

- Limit salt intake
  - Sodium < 2400 mg/day (less than 1500 mg/day if high blood pressure is present)
- Maintain a healthy blood pressure
  - < 120/80
- Avoid or limit caffeine
  - High caffeine causes the body to excrete more calcium
- Avoid alcohol and smoking
  - They are toxic to bone cells
- Get adequate sunshine and vitamin D

55 © 2005 - 2006 Wellsource, Inc. All rights reserved.



## Preventive Actions Continued

- Reduce animal proteins, use more plant-based proteins
- Get adequate calcium in the diet daily
- Get adequate vitamin K daily
- Do regular, weight bearing and strength building exercises
- Be careful to prevent falls
- If recommended by doctor, screen for bone density and take medication if prescribed

56 © 2005 - 2006 Wellsource, Inc. All rights reserved.



## Interaction of Genetics and Lifestyle

### Hormones Produced by the Body

Adhesion proteins ~ Collagen proteins ~ Enzyme proteins  
Calcium-binding proteins ~ Testosterone ~ Estrogen  
Mineralization proteins ~ Cytokines ~ Growth factors

### Weight-bearing Activity

Walking ~ Running  
Jumping  
Weight-lifting

### Nutrition

Plant-based diet  
and proteins  
Adequate nutrients

57 © 2005 - 2006 Wellsource, Inc. All rights reserved.



## END

For more information:

Wellsource Institute of Healthy Living

[www.Wellsource.org](http://www.Wellsource.org)



58 © 2005 - 2006 Wellsource, Inc. All rights reserved.

