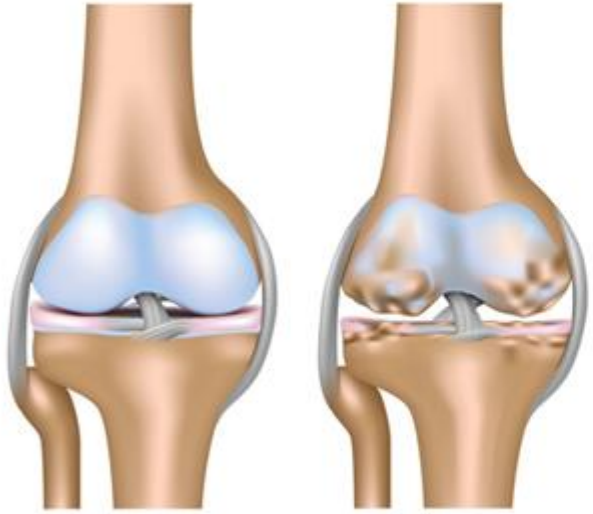
ورزش و پوکی استخوان

Exercise and osteoporosis



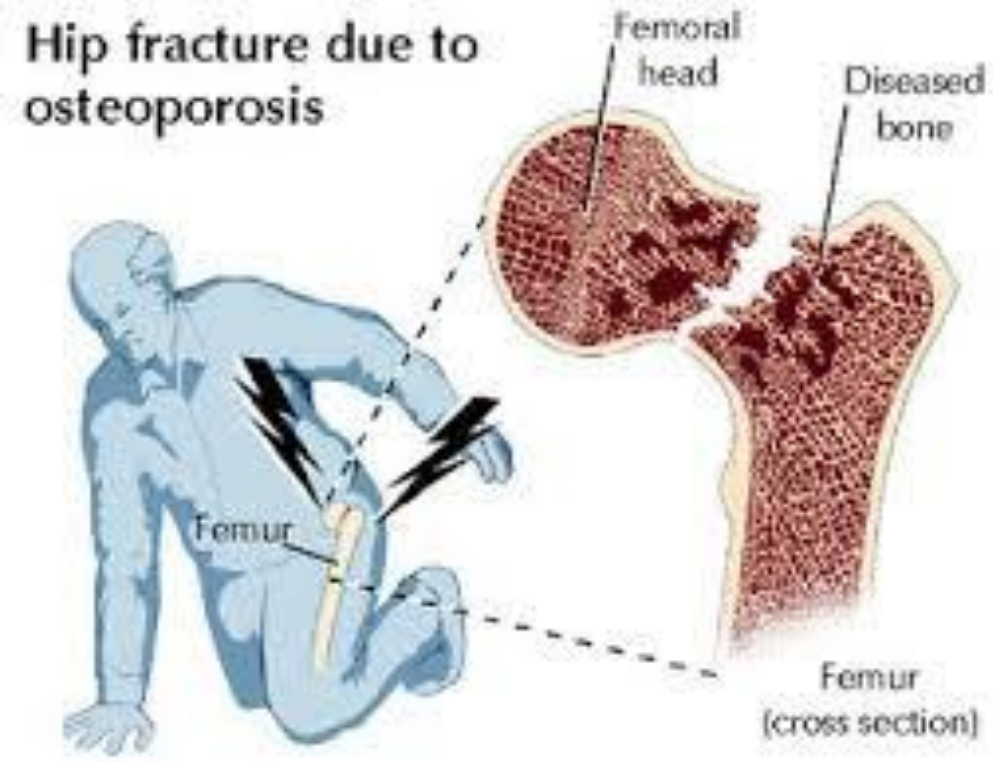
Healthy knee joint

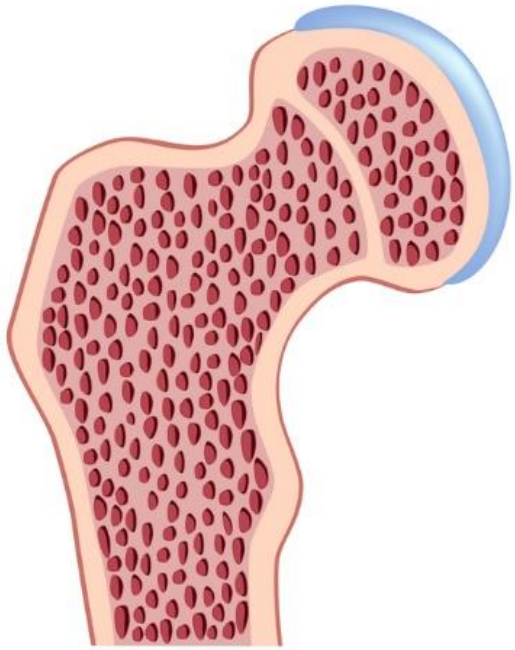
Osteoarthritis

Healthy bone

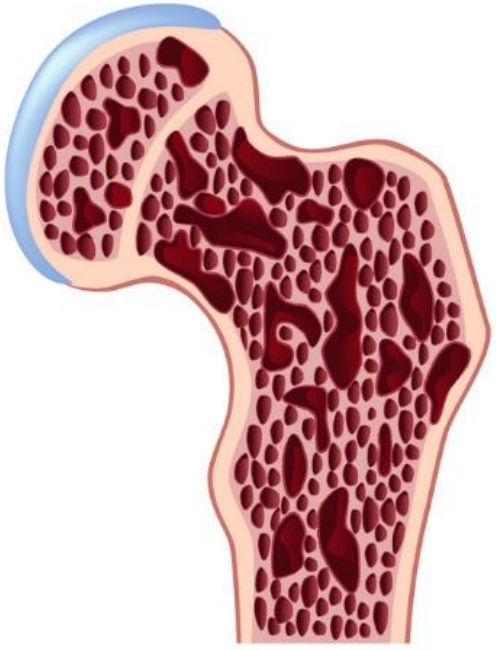
Osteoporotic bone

Osteoporosis



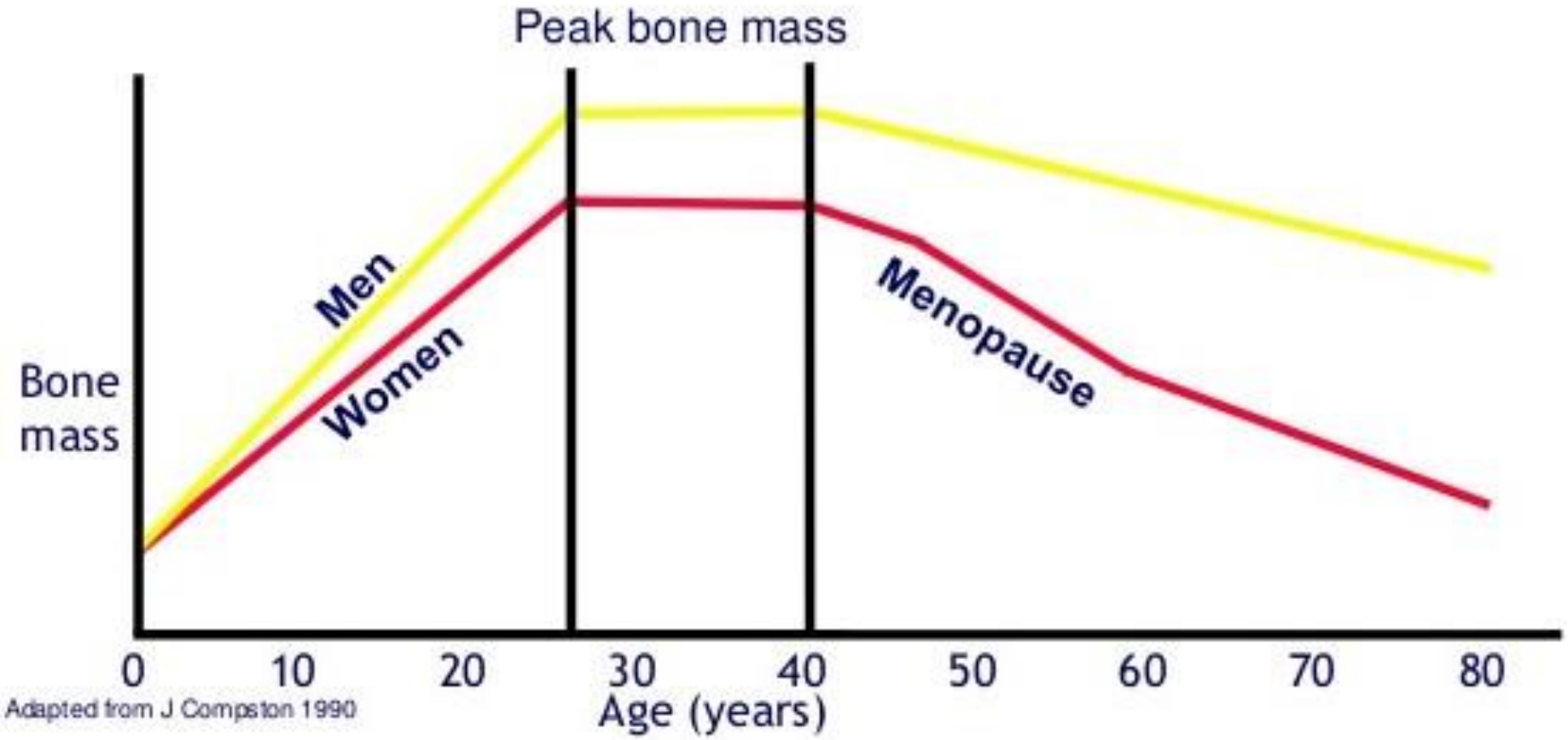


Healthy bone

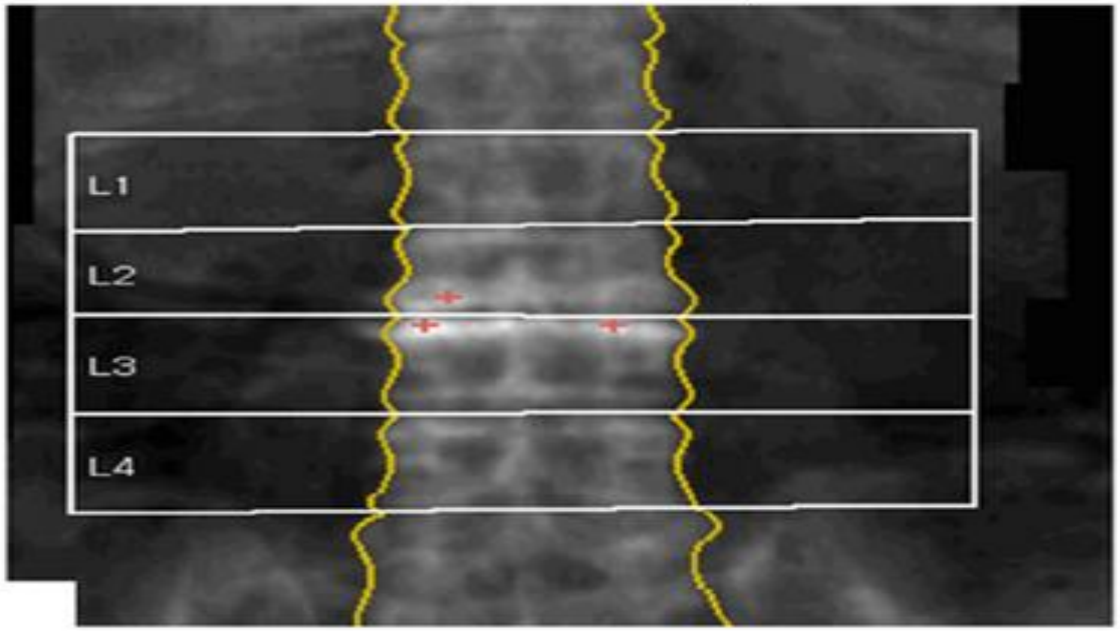


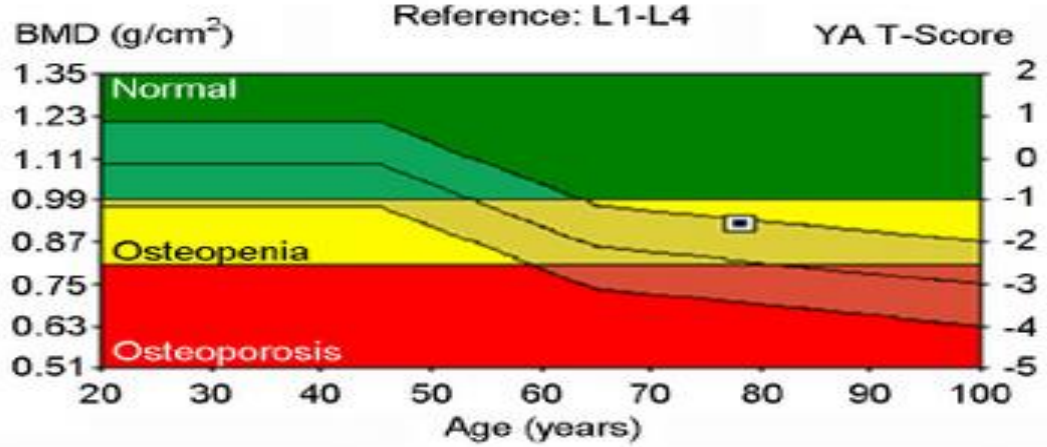
Osteoporosis

Changes in bone mass with age



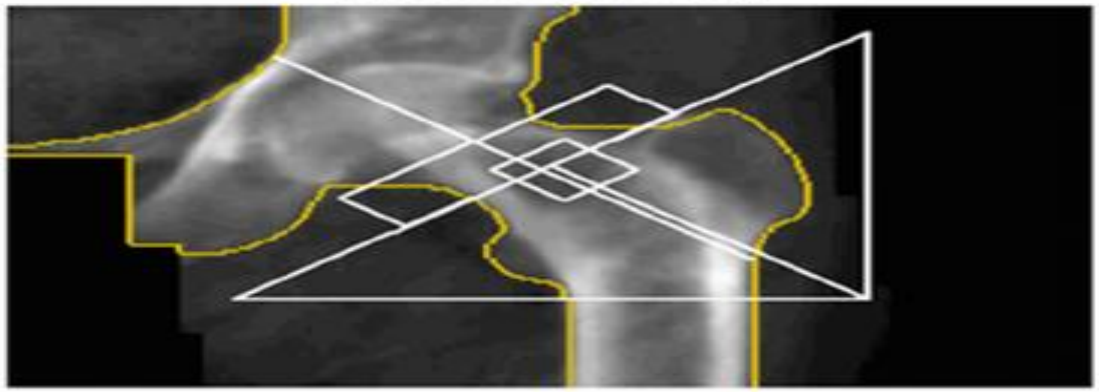
AP Spine Bone Density

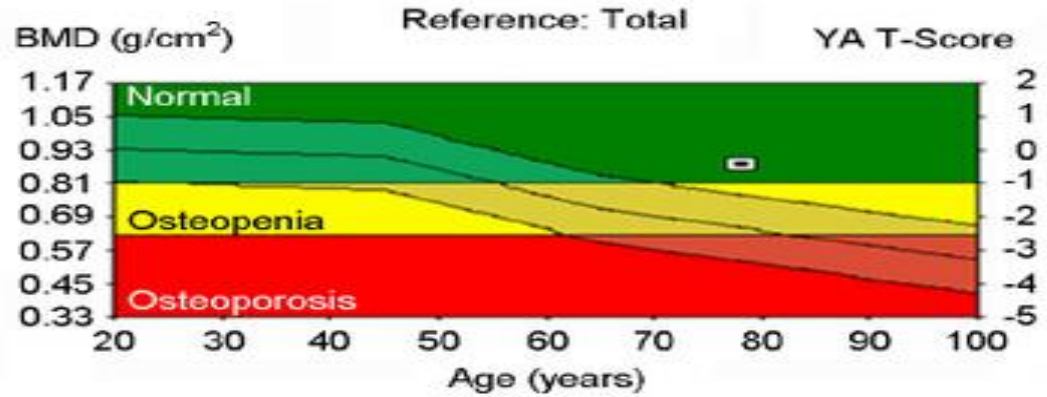




Region	[1] BMD (g/cm²)	Young – [2] Adult T-B core		Age – [3] Matched Z-B core	
		(%)		(%)	
L1	0.681	64	-3.2	89	-0.7
L2	1.030	92	-0.8	125	1.7
L3	1.097	98	-0.2	133	2.3
L4	0.846	76	-2.3	102	0.2
L1-L4	0.920	83	-1.6	113	0.9

Left Femur Bone Density

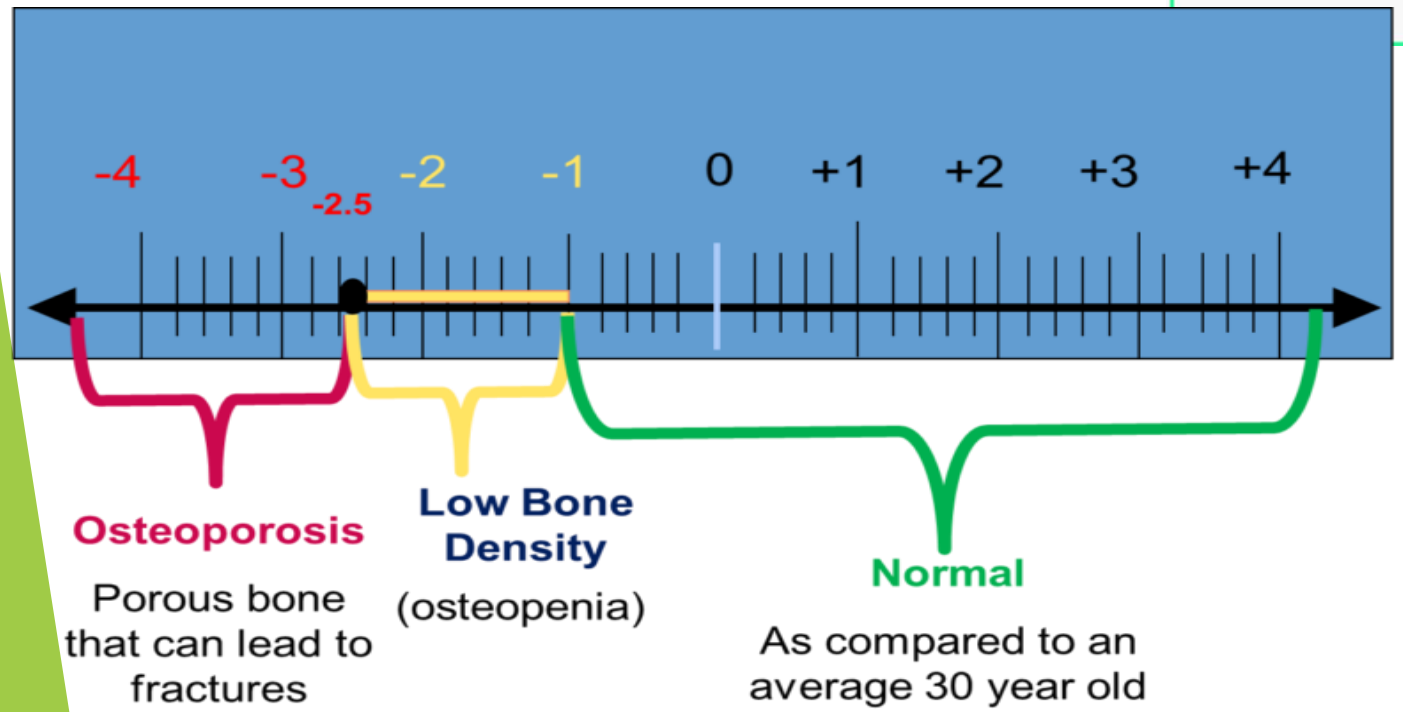




Region	[1] BMD (g/cm²)	Young – [2] Adult T-B core		Age – [3] Matched Z-B core	
		(%)		(%)	
Neck	0.806	90	-0.8	134	1.7
Upper Neck	0.710	–	–	–	–
Wards	0.506	57	-2.9	110	0.3
Troch	0.731	97	-0.2	129	1.5
Shaft	1.032	–	–	–	–
Total	0.883	95	-0.4	135	1.9

T-score

(1) definition of T-score	T-score x	=	(BMD - peakBMD x) / SD x
(2) rearrange	BMD - peakBMD x	=	T-score x * SD x
(3) rearrange	BMD	=	(T-score x * SD x) + peakBMD x
(4) white female	T-score WF	=	(BMD - .858) / .120
(5) substitute BMD from 3rd equation	T-score WF	=	((T-score x * SD x) + peakBMD x - .858) / .120
white male		=	((T-score WM * .137) + .934 - .858) / .120
black female		=	((T-score BF * .133) + .950 - .858) / .120
black male		=	((T-score BM * .168) + 1.074 - .858) / .120
Hispanic female		=	((T-score HF * .111) + .874 - .858) / .120
Hispanic male		=	((T-score HM * .137) + .982 - .858) / .120



T-Score	% of Bone Loss
0.0	0
-1.0	10%
-2.0	20%
-2.5	25%
-3.0	30%
-4.0	40%

پوکی استخوان

- مناطقی از بدن که دارای استخوان های اسفنجی می باشند بیشتر دچار پوکی استخوان می شوند شامل: گردن، ستون فقرات، دنده ها، ساعد و مفصل ران
- این بیماری در مردان و زنان دیده می شود اما شیوع آن در زنان بالاتر است.
- احتمال شکستگی به شدت پوکی استخوان، تعداد و شدت افتادن ها و توده بافت نرم کنار استخوان بستگی دارد.
- کاهش ۱۰ درصدی تراکم استخوان موجب دو برابر شدن خطر شکستگی می شود.

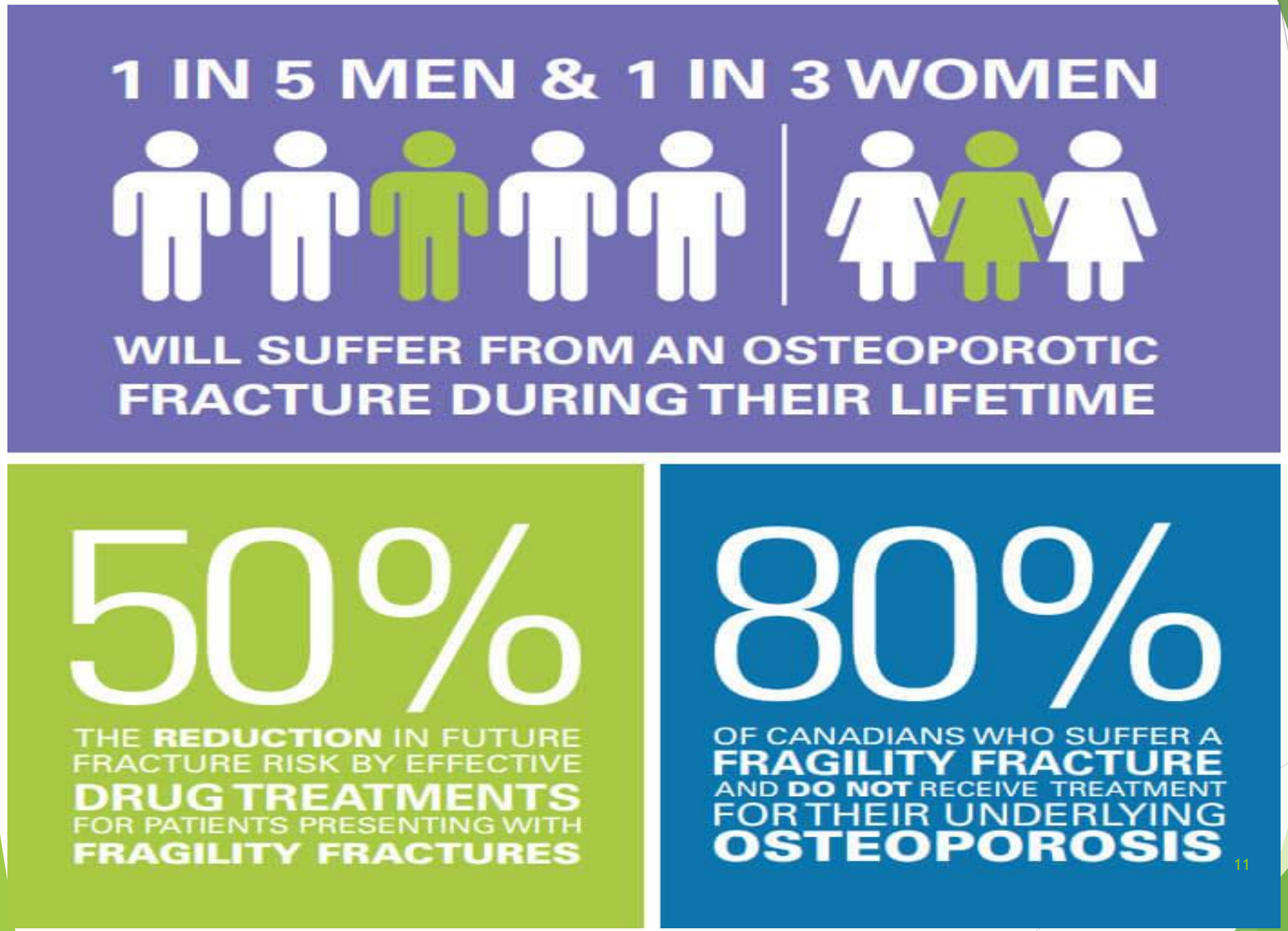
نکته

- پوکی استخوان برگشت پذیر نیست و به همین دلیل درمان ندارد.
- کسانی که دچار پوکی استخوان می شوند فقط می توانند جلوی بدتر شدن پوکی استخوان را بگیرند.
- برای جلوگیری از شکستگی استخوان در این بیماران باید از افتادن ها جلوگیری کرد و توده عضلانی را افزایش داد تا فشار به استخوان ها کمتر شود.

::Who is at RisK ??::

Risk factors you cannot change include:

- Gender. Women get osteoporosis more often than men.
- Age. The older you are, the greater your risk of osteoporosis.
- Body size. Small, thin women are at greater risk.
- Ethnicity. White and Asian women are at highest risk. Black and Hispanic women have a lower risk.
- Family history. Osteoporosis tends to run in families. If a family member has osteoporosis or breaks a bone, there is a greater chance that you will too.


1 IN 5 MEN & 1 IN 3 WOMEN
WILL SUFFER FROM AN OSTEOPOROTIC FRACTURE DURING THEIR LIFETIME
50%
THE REDUCTION IN FUTURE FRACTURE RISK BY EFFECTIVE DRUG TREATMENTS FOR PATIENTS PRESENTING WITH FRAGILITY FRACTURES
80%
OF CANADIANS WHO SUFFER A FRAGILITY FRACTURE AND DO NOT RECEIVE TREATMENT FOR THEIR UNDERLYING OSTEOPOROSIS

Other risk factors are:

- Sex hormones. Low estrogen levels due to missing menstrual periods or to menopause can cause osteoporosis in women. Low testosterone levels can bring on osteoporosis in men. [During menopouse,bone loss can range from 4 to 8%]
- Calcium and vitamin D intake. A diet low in calcium and vitamin D makes you more prone to bone loss. [In Malaysia most people hate drinking milk and hence increase their probability towards osteoporosis]
- Medication use. Some medicines increase the risk of osteoporosis.
- Too Much acidity in Food. As the blood must be a neutral pH, your body pulls calcium from the bones to neutralize the acidity. This is often the major factor in the development of osteoporosis
- Activity level. Lack of exercise or long-term bed rest can cause weak bones.
- Smoking. Cigarettes are bad for bones, heart, and lungs.
- Drinking alcohol. Too much alcohol can cause bone loss and broken bones.
- Lack of magnesium may be the cause of osteoporosis.

  Calcitonin relies on magnesium to function properly.

Some truths about the “alkaline diet”

mysportscience
Unlock the Power of Science to Optimise Performance
@jeukendrup
www.mysportscience.com

An acid-producing diet does not leach calcium from your bones

Blood pH is tightly controlled between 7.35 and 7.45 — slightly alkaline (Diet has little or no influence on this)

The body regulates pH independent of the diet.

The promotor of the diet Robert O. Young, was sentenced to prison for practicing medicine without a license.

An alkaline diet does not prevent or cure cancer as claimed

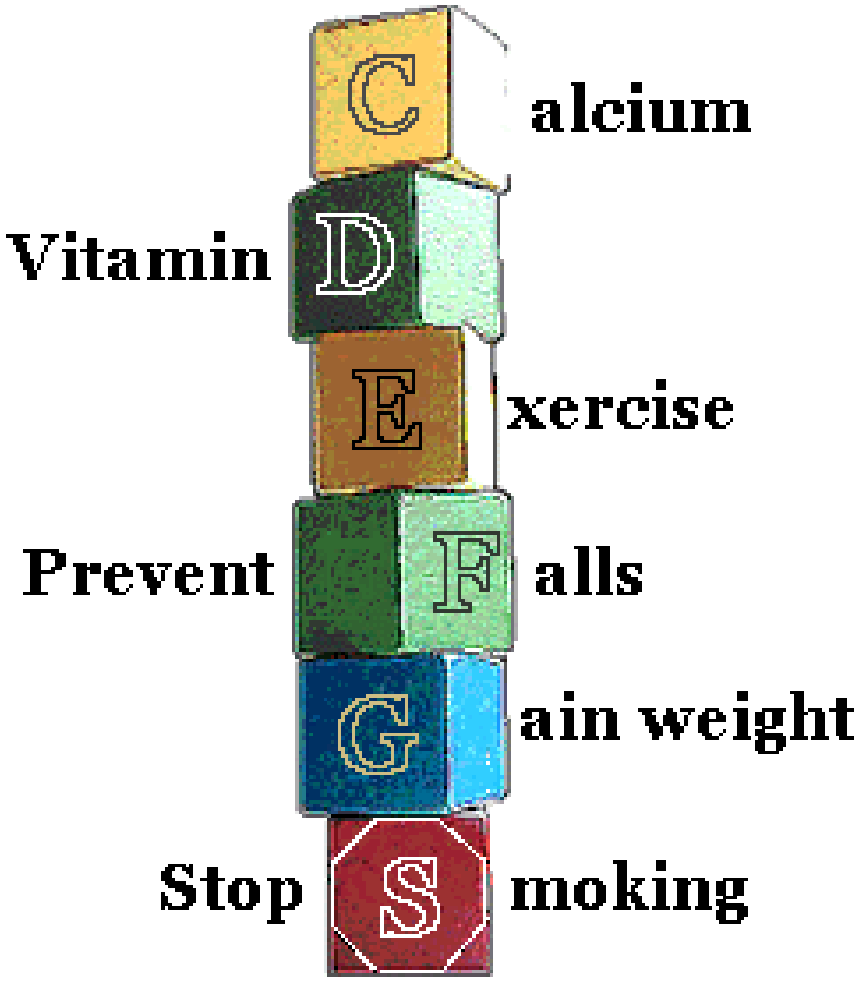
Proponents measure pH of urine but this does not tell you anything about blood pH

Bottomline…. It is a stubborn myth.

OSTEOPOROSIS RISK FACTORS

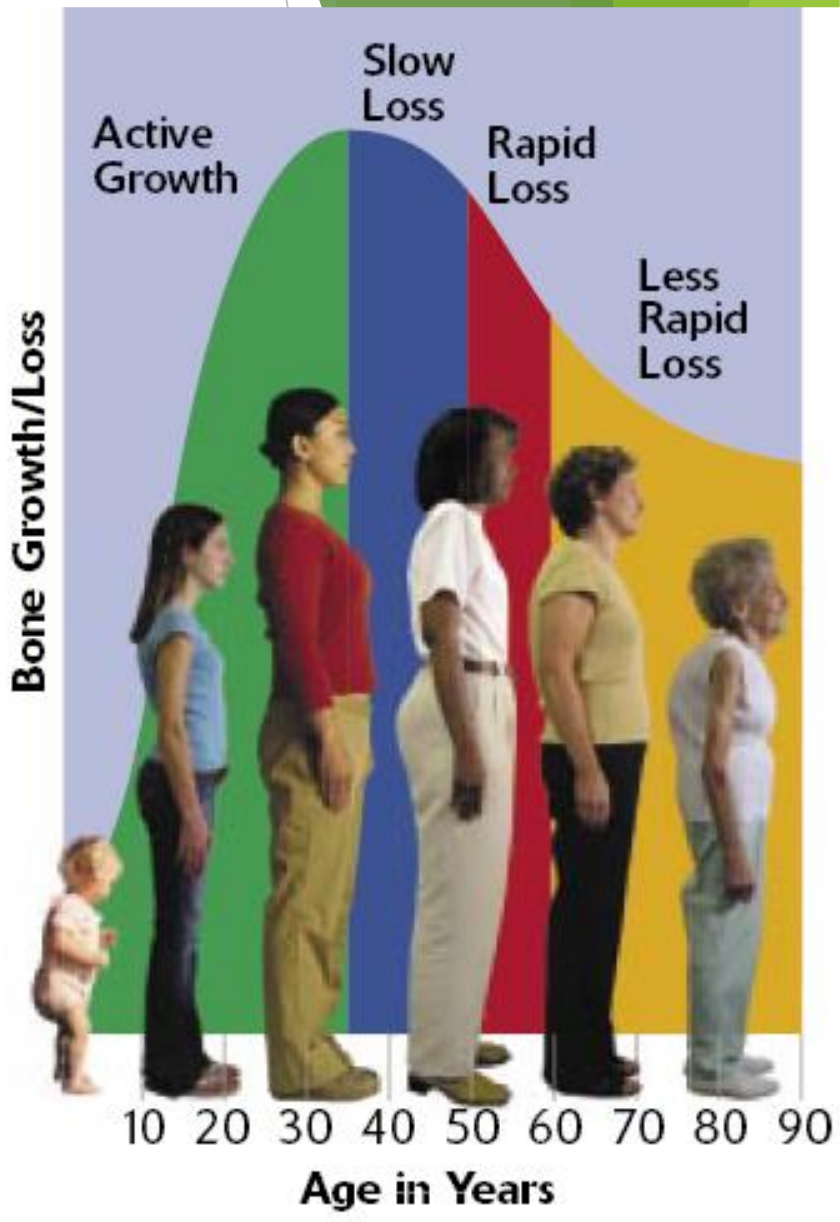
"Access" (leads to) Osteoporosis

Bone Health Building Blocks



پیشگیری

- میزان توده استخوان در افراد مسن بستگی میزان توده استخوانی در دهه سوم زندگی دارد زیرا حداکثر توده استخوانی هر فرد در این دهه می باشد.
- مقدار توده استخوانی در این سن بستگی به عوامل ژنتیکی و مادر زادی، تغذیه، فعالیت بدنی، هورمون ها، دارو ها و بیماری ها دارد.
- کسانی که کمبود استروژن دارند باید تحت درمان قرار گیرند.
- استروژن موجب کاهش برداشت کلسیم از استخوان، افزایش جذب کلسیم از روده ها و بهبود اثر بخشی ورزش بر استخوان می شود.
- بعد از سن یائسگی در زنان توده استخوان به شدت کاهش می یابد.



پیشگیری

- استروژن تراپی در زنان یائسه سبب جلوگیری از پوکی استخوان و بیماری عروق کرونر می شود ولی خطر سرطان را افزایش می دهد.
- خانم هایی که ۱۰ سال استروژن دریافت کردند احتمال مرگ به علت سرطان پستان در آنها ٤٣ درصد افزایش یافت.
- بنابراین بهترین راه جلوگیری از پوکی استخوان ورزش مداوم و رژیم غذایی حاوی ۱۰۰۰ میلی گرم کلسیم و ۵۰۰ تا ۸۰۰ واحد ویتامین D می باشد.

پیشگیری از افتادن

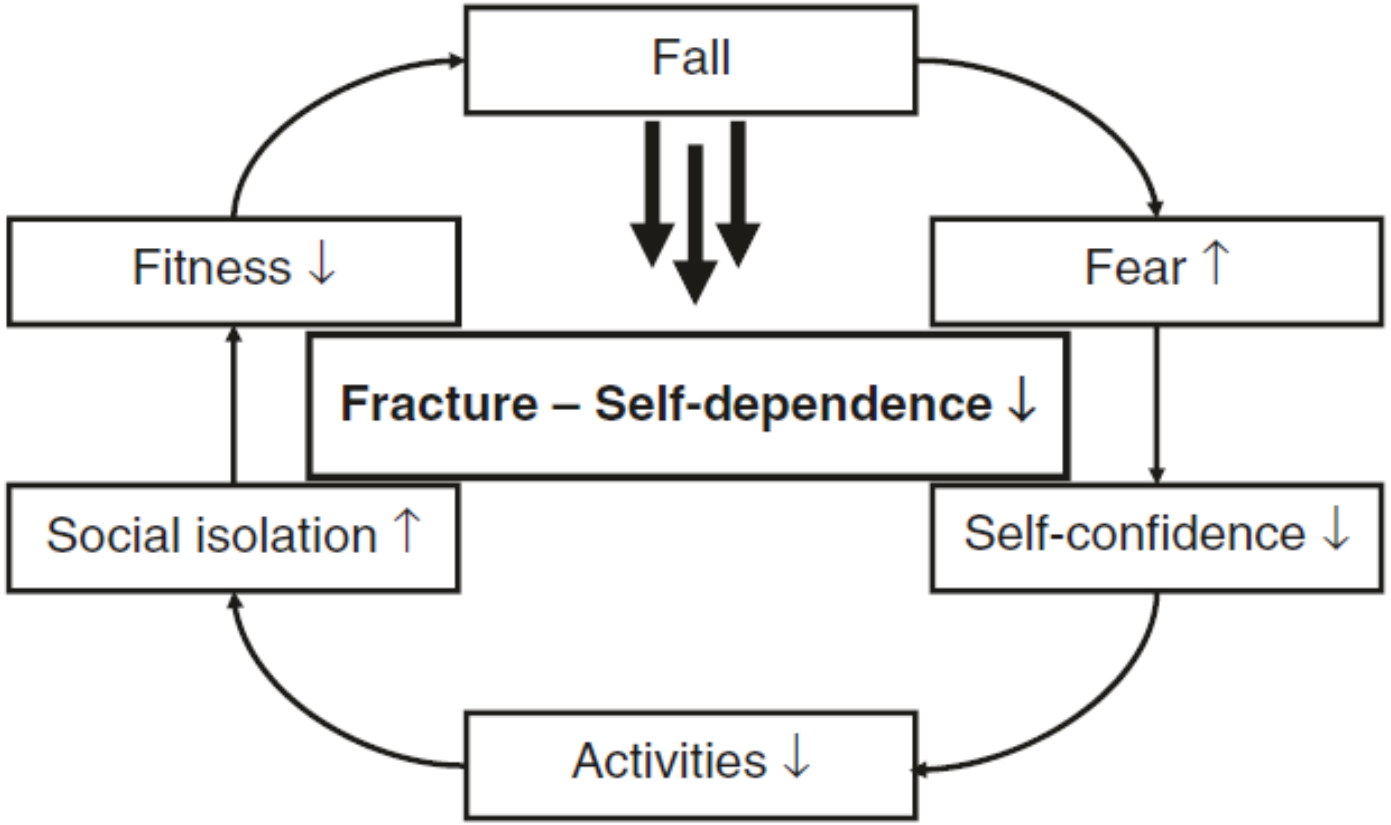


Fig. 13.2 Consequences of a fall

Risk of falls consists of extrinsic and intrinsic factors

Table 7.4 Extrinsic factors

Inappropriate footwear
Insufficient ambulatory aids
Environmental (i.e., poor illumination, unevensurface, loose carpeting, slippery floor, etc.)
Pets

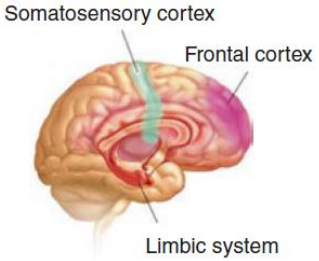
Table 7.5 Intrinsic factors

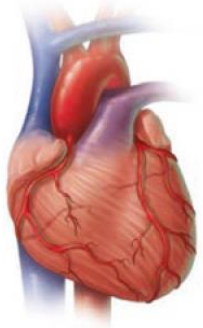
Visual impairment
Vestibular changes
Impaired proprioception
Cognitive decline/CNS degeneration
Postural changes, imbalance, gait unsteadiness
↓ coordination, ↓ agility
↓ muscle strength (48% risk)
↓ joint flexibility
Orthopnea → postural hypotension → cardiovascular deconditioning
Iatrogenically reduced alertness: ↓ antidepressants, use alternatives if possible, ↓ use of allergy and sleep medications

Central and Peripheral Nervous System Factors
Required for Steadiness of Gait

Input:

Vestibular system
Visual system
Sensory nerves





Nervous System Output:

Frontal cortex planning
Basal ganglia
initiation automatisation
Brainstem
integration
Cerebellum
coordination, adaptation
Spinal cord
spinal pattern generators
Nerve roots
Peripheral nerves
(both motor and sensory)

Support System:

Cardiovascular system
Bones
Muscles
Joints
Ligaments
Feet

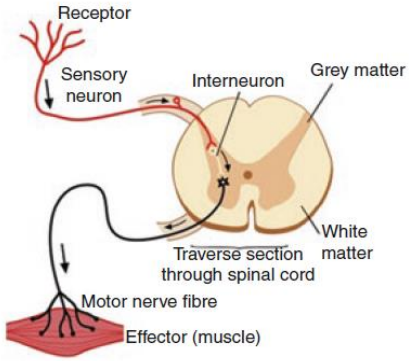


Fig. 15.7 This illustration indicates physiologic factors whose function contributes to norm
locomotion

تغذیه

Table 5.2 Recommended dietary allowance of calcium and vitamin D (adapted from the Food and Nutrition Board of the Institute of Medicine, 2004)

Age, years	Calcium (mg/day)	Vitamin D (IU/ day)
1–3	700	600
4–8	1000	600
9–18	1300	600
19–50	1000	600
51–70 (male)	1000	600
51–70 (female)	1200	600
Greater than 70	1200	800
Pregnant and/or nursing women <19	1300	600
Pregnant and/or nursing women 19–50	1000	600

Table 5.1 Calcium content of common food items

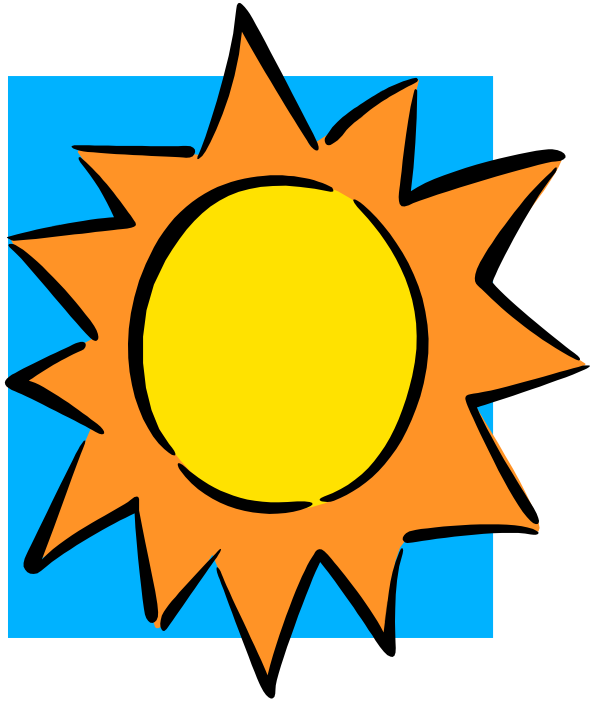
Food item, serving size	Calcium content (mg)
Milk (skim, 1%, 2% or whole), 1 cup	300
Low-fat yogurt, 6 oz. [≈180 g]	310
Cheese	
American, 1 oz. [≈30 g]	125
Cheddar, 1 oz. [≈30 g]	200
Swiss, 1 oz. [≈30 g]	270
Spinach (cooked), ½ cup	120
Broccoli (cooked), ½ cup	50
Kale (cooked), ½ cup	90
Orange juice (calcium fortified), ½ cup	250
Almonds, 1 oz. [≈30 g]	70
Salmon (canned with bones), 3 oz. [≈90 g]	180
Macaroni and cheese, 1 cup	200

Food	Portion	Vitamin D content per portion
Wild salmon	100 g	~ 600-1,000 IU vitamin D_3
Fish farming salmon	100 g	~ 100-250 IU vitamin D_3
Canned sardine	100 g	~ 300 IU vitamin D_3
Canned mackerel	100 g	~ 250 IU vitamin D_3
Canned tuna	100 g	~ 230 IU vitamin D_3
Cod liver oil	5 mL	~ 400-1,000 UI vitamin D_3
Egg yolk	1 unit	~ 20 IU vitamin D_3
Fresh mushroom	100 g	~ 100 IU vitamin D_2
Sun dried mushroom	100 g	~ 1,600 IU vitamin D_2

Adapted from ref. 3.

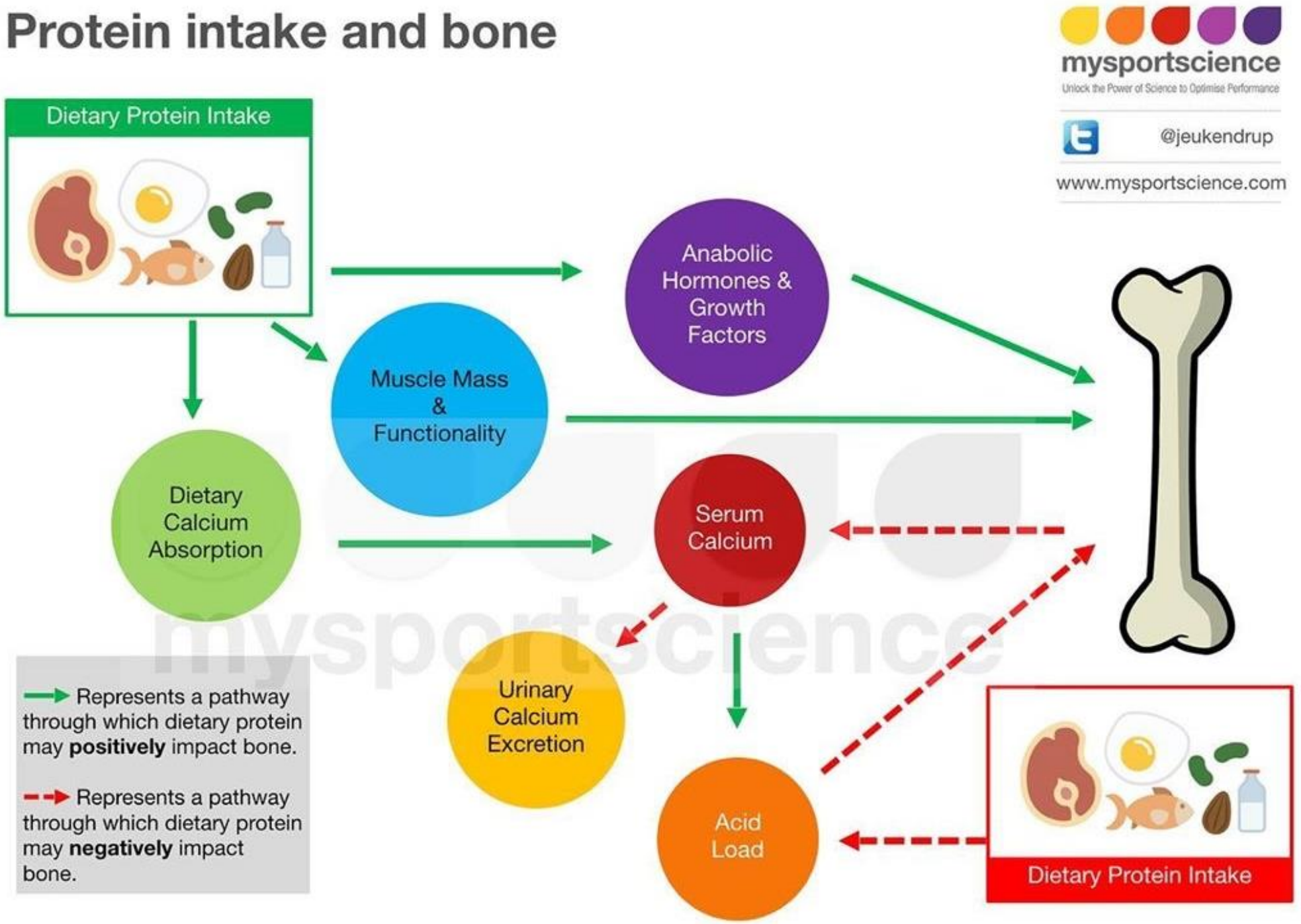
Vitamin D necessary for calcium absorption

- 10–15 minutes exposure of hands, arms and face 2–3 times/week may be sufficient (depending on skin sensitivity).



- 80 تا 90 درصد ایرانی ها کمبود ویتامین دی دارند.
- ایرانی تبار ها در امریکا سطح ویتامین دی پایین تری نسبت به بقیه دارند.

Protein intake and bone



الکل و استخوان

- There was a lower fracture risk in persons consuming between 0.5 and 1.0 drink per day (OR 0.8, CI 0.71–0.91) when compared to abstainers.
- However, increasing consumption to greater than two drinks daily increased the risk by 40% (CI 1.08–1.79).
- One alcoholic beverage a day is equivalent to 1.5 oz. [≈40 mL] of hard liquor, 12 oz. [≈350 mL] of beer, or 5 oz. [≈140 mL] of wine.

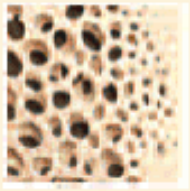
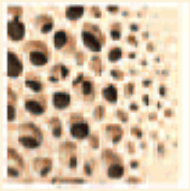
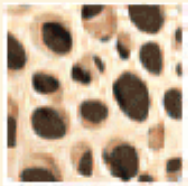
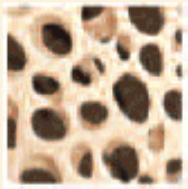
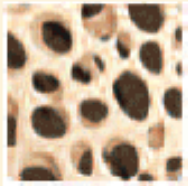
ویتامین k

- Vitamin K is a cofactor for the metabolism of osteocalcin, an important component of the bone extracellular matrix [13].
- Vitamin K has also been shown to positively affect calcium homeostasis and may work synergistically with vitamin D [14].
- Epidemiologically, vitamin K has been shown to be beneficial to bone health with higher vitamin K intake associated with higher bone mineral density and lower risk of fracture [15].
- However, data from randomized controlled trials assessing the efficacy of vitamin K supplementation on improving bone density and /or reducing fracture risk has been inconsistent [16].

Phosphorus, Magnesium, and Strontium

کمبود این مواد کم گزارش شده است.

Nutrition plays an important role in the acquisition of bone mass at many levels. Comprehensive nutritional counselling is important in the prevention of osteoporosis.

Nutrient	Source	Function	Bone Density
Calcium	milk, cheese, butter, yogurt almonds prunes seaweed	Building block of bone Increases bone density	 Increases density
Vitamin D	sunlight eggs cheese leafy greens dates	Builds and maintains healthy bones Maintains calcium balance Reduces frequency of falls and fractures	 Increases density
Protein	lean meat fish poultry eggs nuts beans	Osteoporosis prevention and treatment Diets high in protein can induce a negative calcium balance, which could lead to bone loss	 Excess decreases density
Sodium	salted foods	Promotes calciuria Excess dietary sodium may reduce bone mineral density	 Excess decreases density
Caffeine	coffee soft drinks	Decreases bone density Increases risk of hip fracture	 Decreases density

فواید تمرینات ورزشی برای بیماران پوکی استخوان

- فشار مکانیکی بر استخوان موجب افزایش تراکم استخوان می شود.
- نیروی عضلانی و نیروی جاذبه زمین موجب تقویت استخوان ها می شود.
- ورزشکاران توده استخوانی قوی تری نسبت به غیر ورزشکاران دارند.
- دونده ها و وزنه برداران استخوان قوی تری نسبت به شناگران دارند.
- تقویت عضلانی ناشی از ورزش موجب کاهش فشار به استخوان ها می شود.
- با ورزش هماهنگی عصب و عضله تقویت شده که دفعات و شدت افتادن ها را کمتر می کند.
- تقویت قلب و بهبود خون رسانی موجب کاهش احتمال سرگیجه ناشی از افت فشار در افراد می شود.

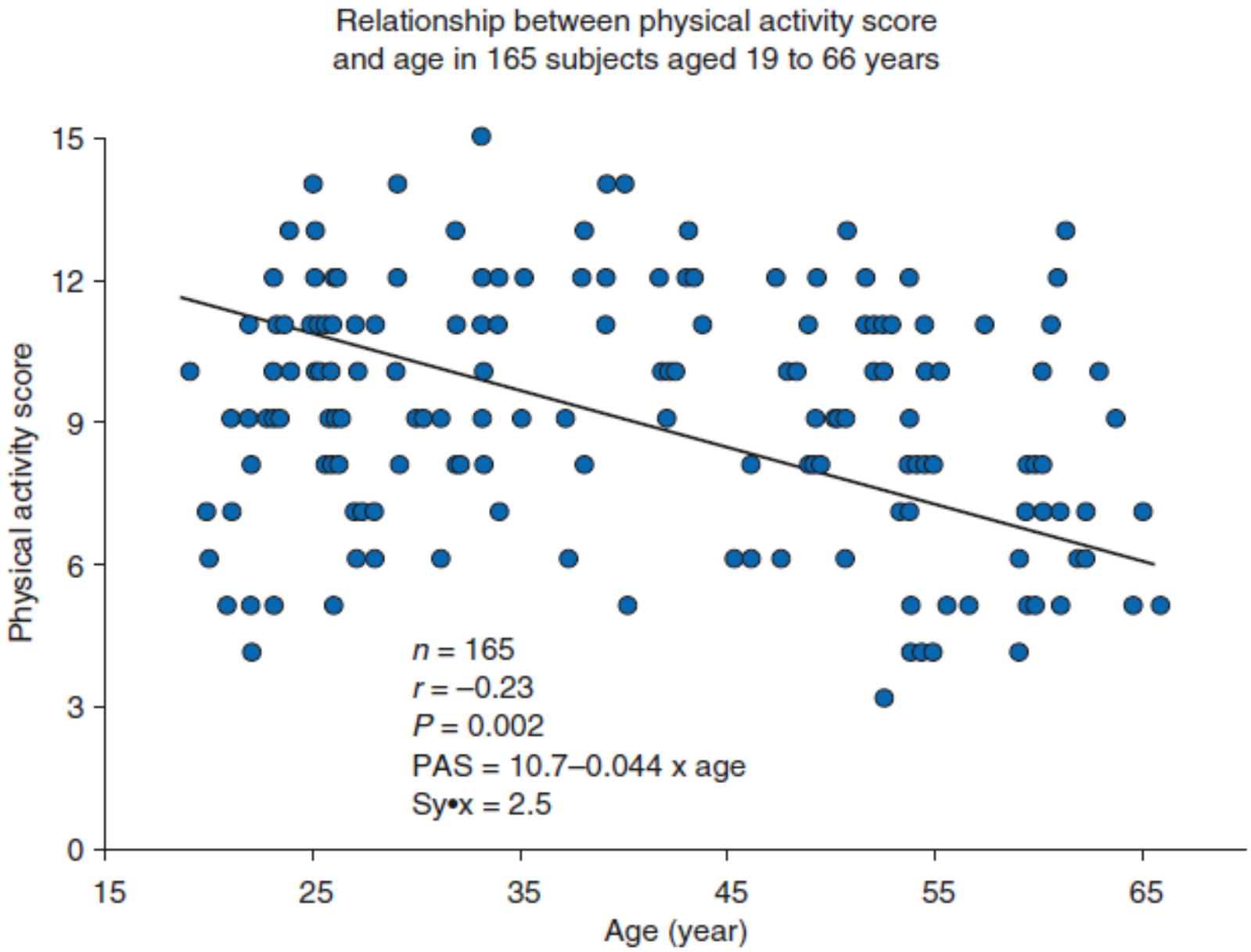


Fig. 1.4 Depicts reduction of physical activity level with increasing age in healthy population. From Sinaki M: Aging Clin Exp Res 10:249–262, 1998; used with permission.

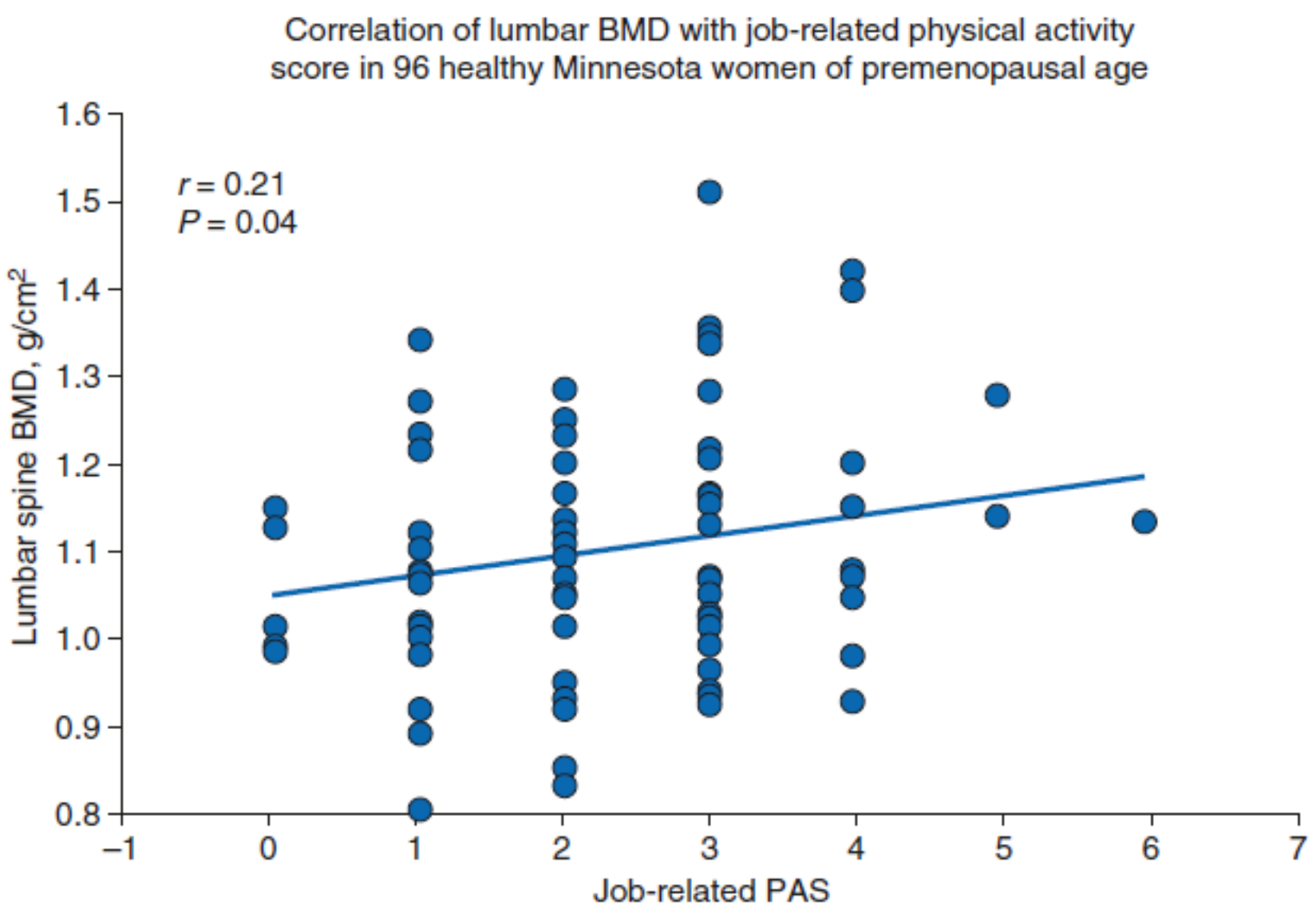


Fig. 1.5 Weight-bearing physical activity whether at job or otherwise could have positive effect on BMD of the spine. From Sinaki M, Fitzpatrick LA, Ritchie CK, Montesano A, Wahner HW. Site-Specificity of Bone Mineral Density and Muscle Strength in Women: Job-Related Physical Activity. Am J Phys Med Rehabil; 77(6):470–476, November/December, 1998; used with permission.

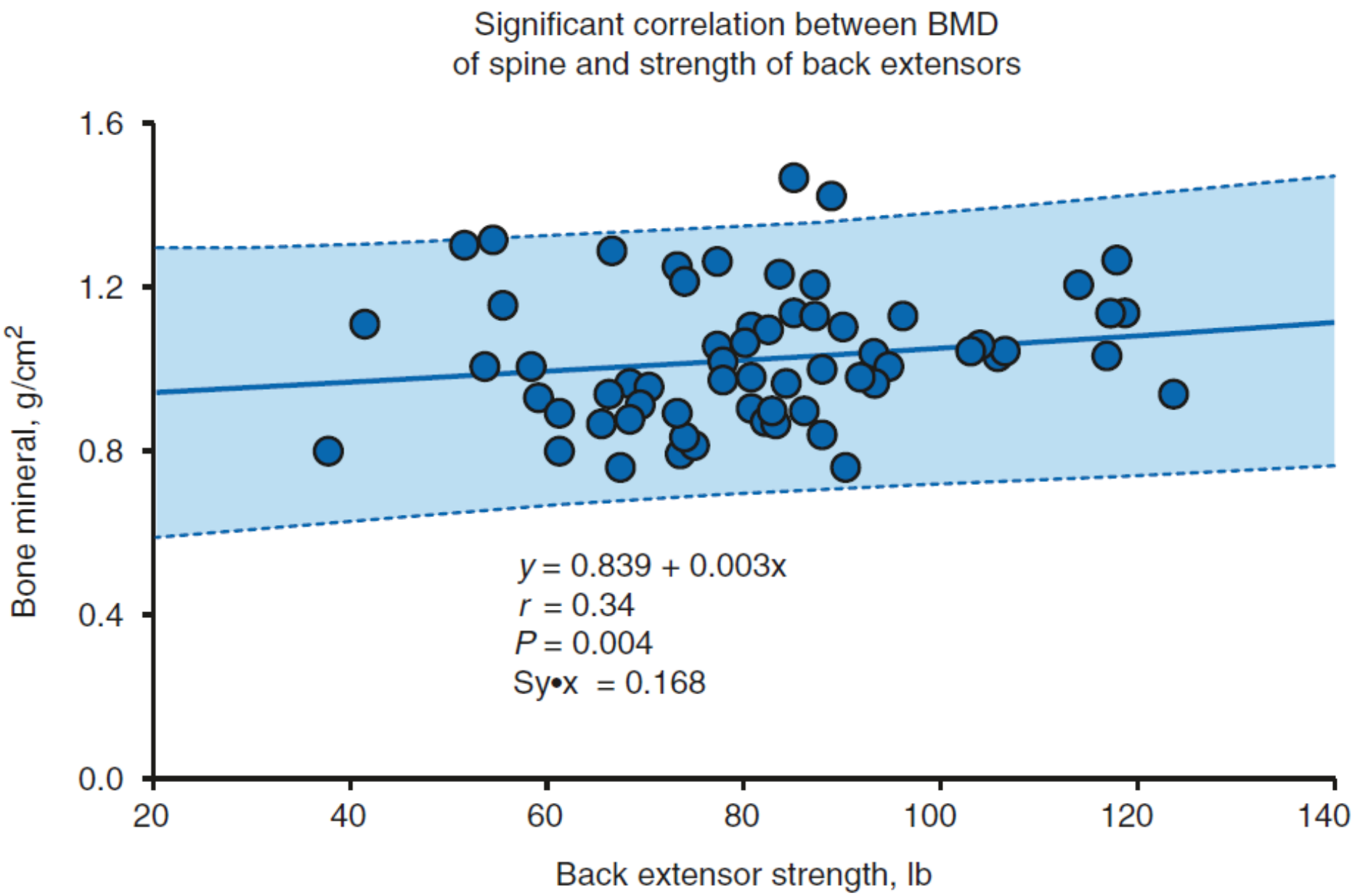


Fig. 7.6 Positive correlation of bone mineral density of the spine with back extensor strength. Data from Sinaki M, McPhee MC, Hodgson SF, Merritt JM, Offord KP. Mayo Clin Proc. 1986

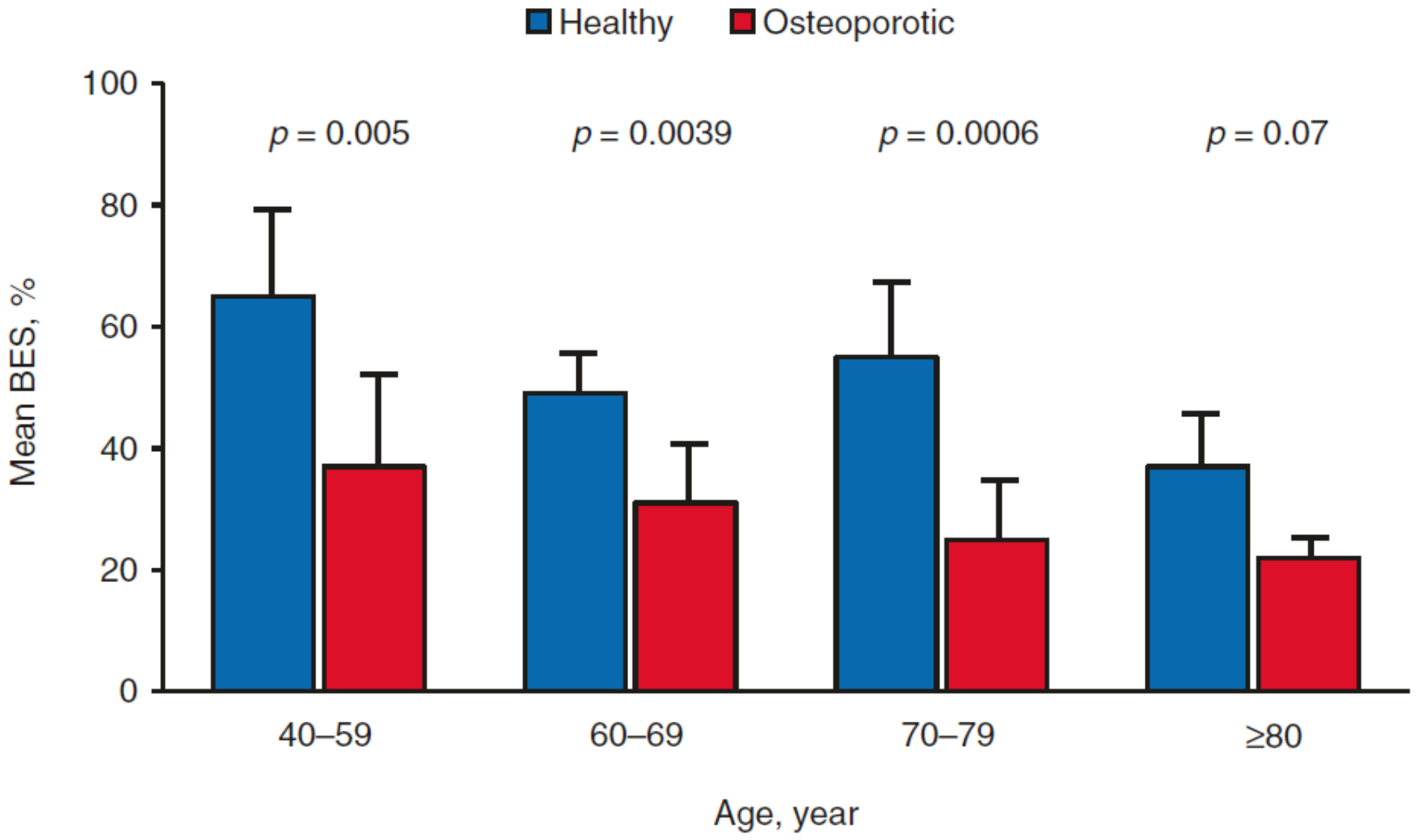
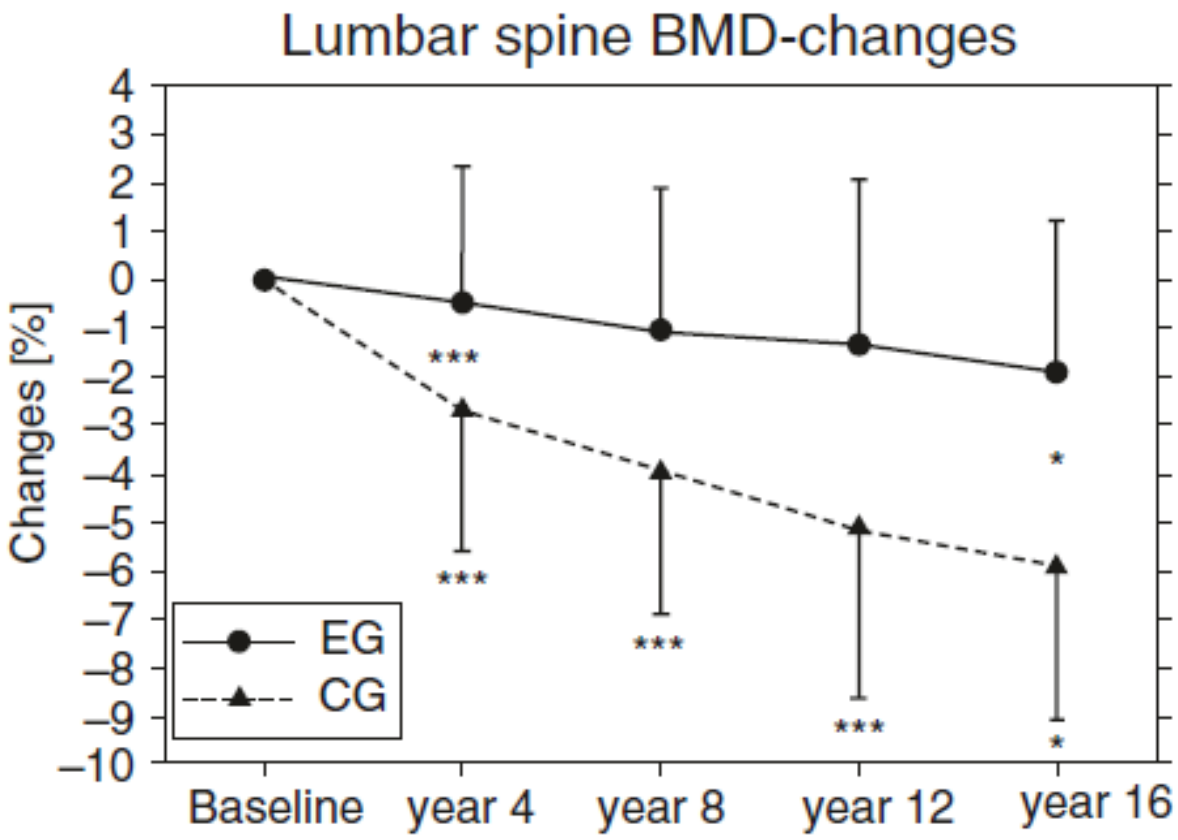


Fig. 7.12 Mean back extensor strength in healthy women and women with osteoporosis. Data from Sinaki M, Khosla S, Limburg PJ, Rogers JW. Muscle strength in osteoporotic versus normal women. Osteoporos Int. 1993;3:8–12.



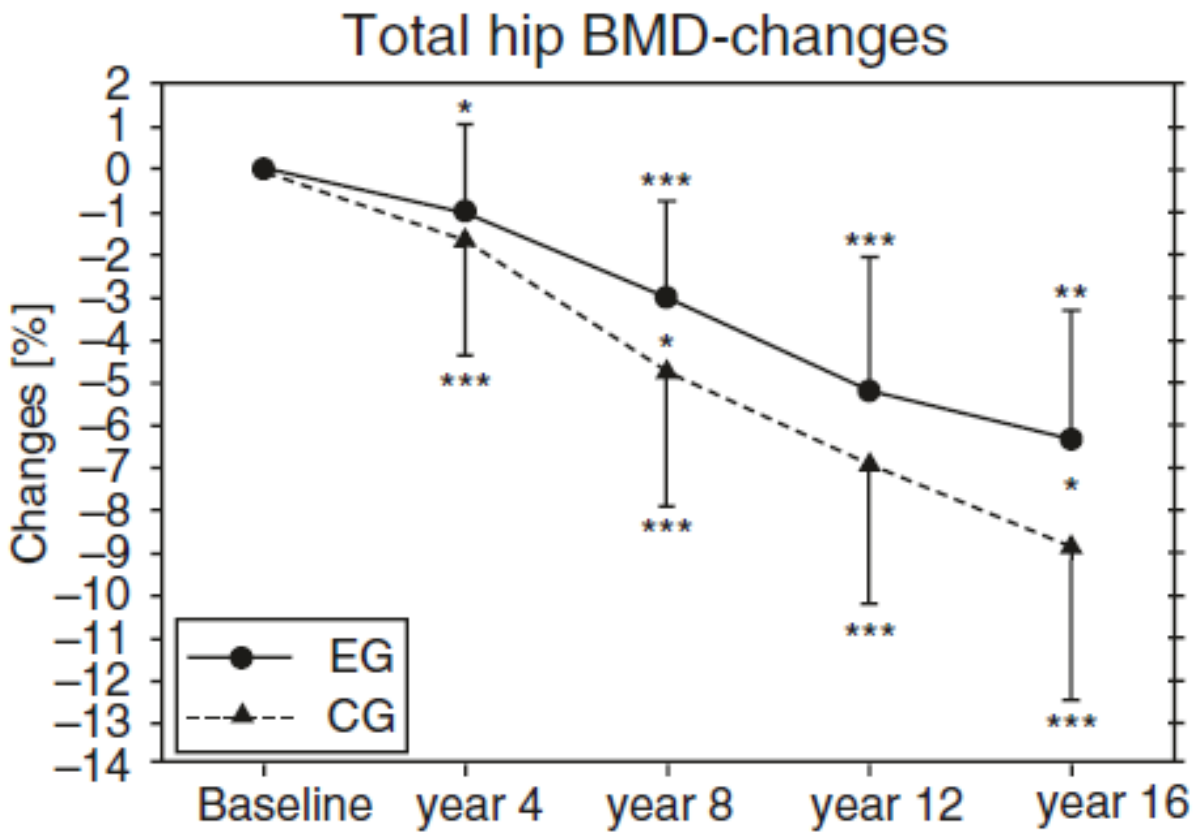


Fig. 6.2 BMD changes at LS and FN during the study course. Asterisks (*$p < 0.05$; $p < 0.001$) indicate either (top of the SD) significant different from the period before or (between the curves) significant group difference (EG vs. CG) for the corresponding period

- Kemmler W, Lauber D, Weineck J, et al. Benefits of 2 years of intense exercise on bone density, physical fitness, and blood lipids in early postmenopausal osteopenic women: results of the Erlangen Fitness Osteoporosis Prevention Study (EFOPS). Arch Intern Med. 2004;164:1084–91.

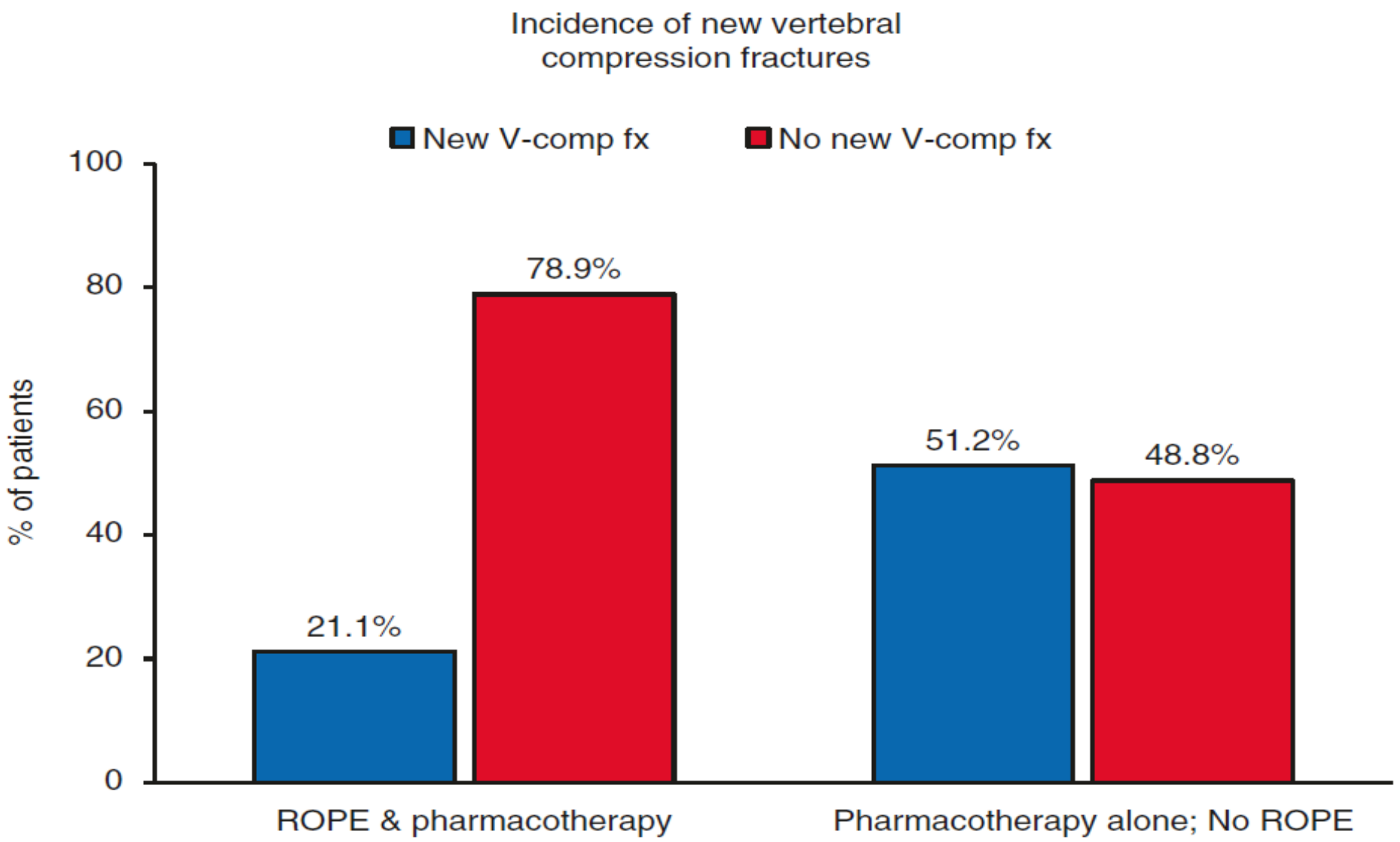


Fig. 7.10 Comparing women with osteoporosis who performed ROPE and pharmacotherapy versus those who used only pharmacotherapy. From Figueroa DAK, Sinaki M. Significant reduction of vertebral fractures: Comparison of rehabilitation of osteoporosis program-exercise (ROPE) versus No-ROPE, with or without pharmacotherapy. J Bone Miner Res. 2007 Sep; 22(Suppl 1):S462. Used with permission.

تجویز ورزش

- ✓ نوع ورزش
- ✓ شدت
- ✓ مدت
- ✓ تعداد جلسات

نوع ورزش

- ✓ پیاده روی
- ✓ دویدن
- ✓ تمرینات مقاومتی

نکته:

- ❖ ورزش هایی که در آن حمل وزن وجود دارد یا فشار به استخوان وارد می آید بهتر است.
- ❖ اما باید توجه داشت مقدار فشار وارده به استخوان ها باید متناسب با چگالی استخوان باشد. در صورت فشار بیش از توان استخوان ها، ورزش ممکن است موجب شکستگی استخوان گردد.
- ❖ شنا یا آبدرمانی می تواند از افتادن در ورزش جلوگیری کند اما احتمال لیز خوردن در محیط استخر بیشتر است.

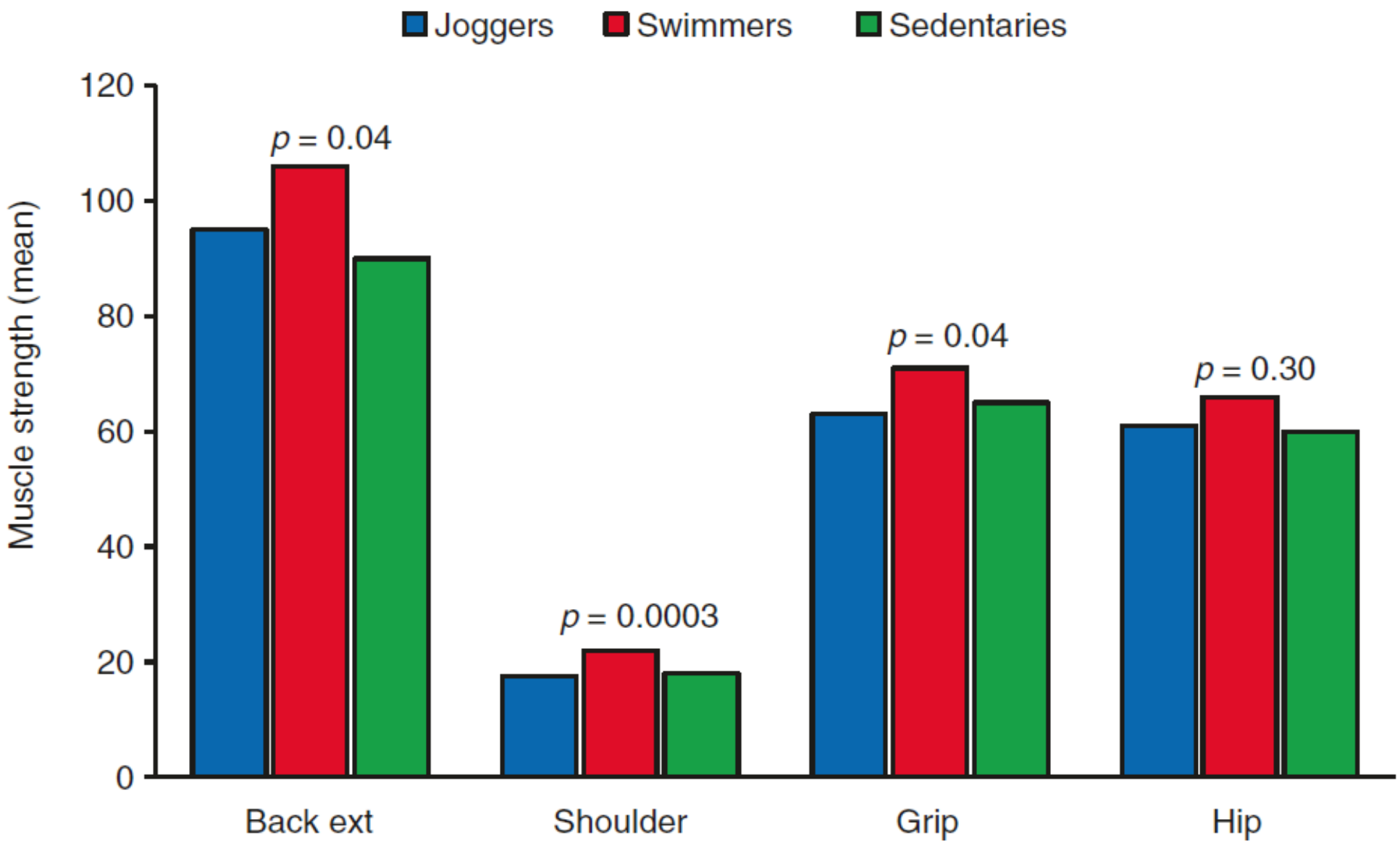
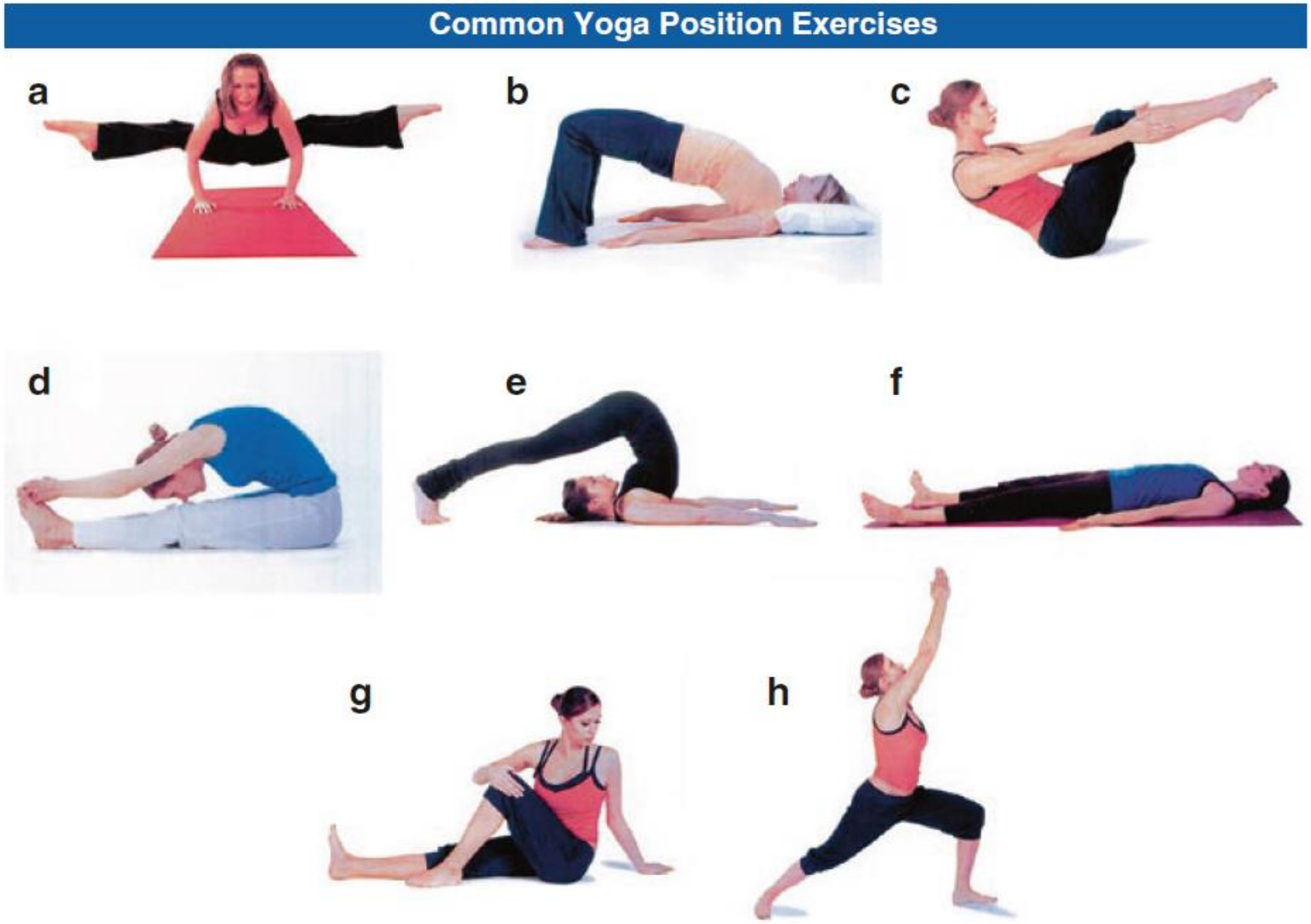


Fig. 7.1 Comparing muscle strength in three groups of female college students (swimmers, joggers, and sedentary). From Emslander HC, Sinaki M, Muhs JM, Chao EY, Wahner HW, Bryant SC, Riggs BL, Eastell R. Mayo Clin Proc. 1998; used with permission.

برخی حرکات در یوگا باعث شکستن استخوان بویژه ستون مهره می شود



تمرین روی سطوح ناپایدار

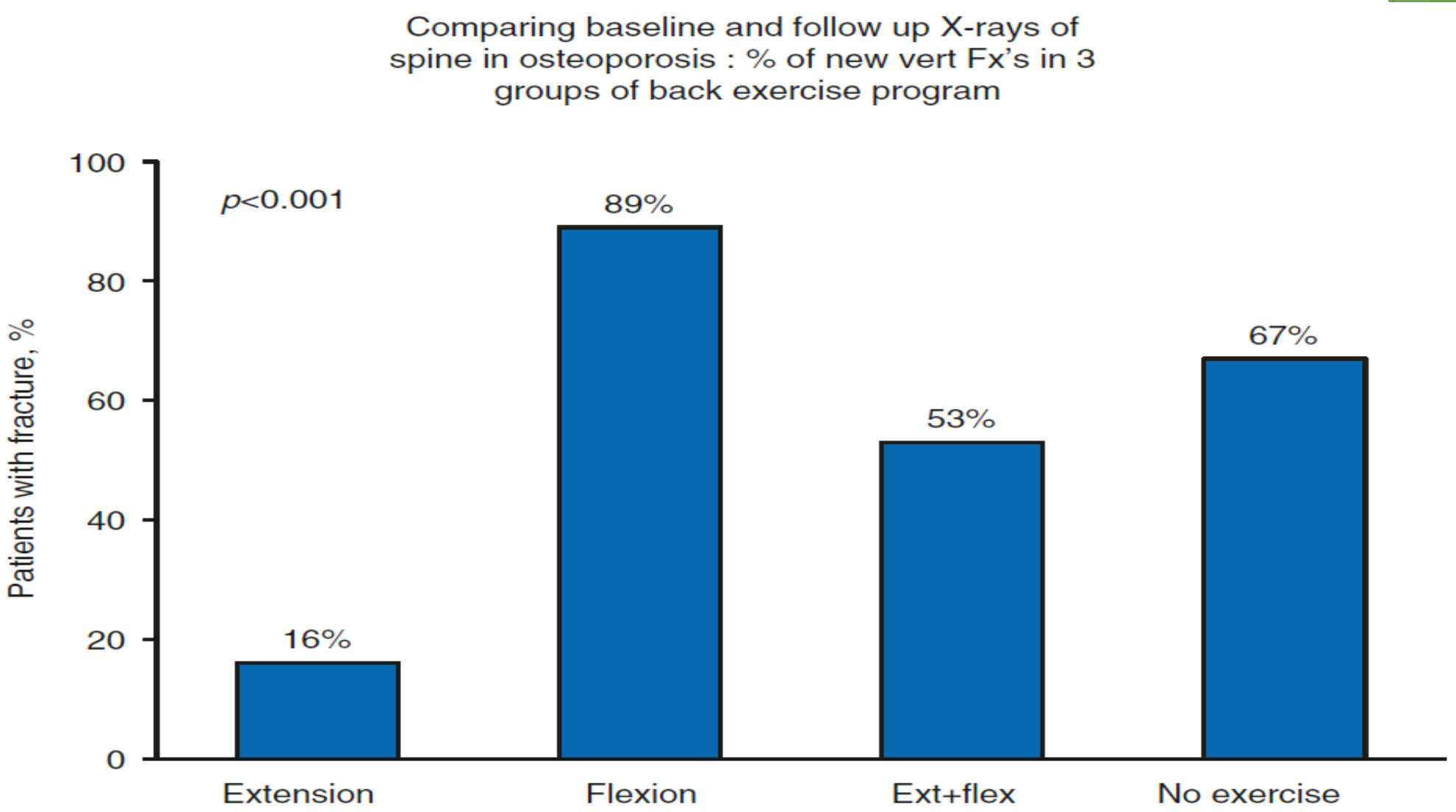


Fig. 7.2 Comparing baseline and follow-up X-rays of the spine in four groups of osteoporotic women after participation in therapeutic back exercises. Percentage of new vertebral fractures in spinal extension; spinal flexion combined with extension; spinal flexion only; and no exercise). *y*-Axis reflects percentage of patients with new vertebral fracture. Figure shows higher percentage of fracture in subjects who performed spinal flexion exercises as therapeutic back exercise program. Data from Sinaki M, Mikkelsen BA: Arch Phys Med Rehabil: 1984.

شدت ورزش

- ✓ درک فشار بین ۱۱ تا ۱۶ مناسب است.
- ✓ ۷۰ درصد یک تکرار بیشینه برای تمرینات با وزنه مناسب است.

RATING OF PERCEIVED EXERTION (RPE)

Borg's Scale (Gunner borg 1982):

6-
7- very, very light
8-
9- very light
10-
11- fairly light
12-
13- somewhat hard
14-
15- hard
16-
17- very hard
18-
19- very, very hard
20-

Modified Borg Scale:

0- at rest
1- very easy
2- somewhat easy
3- moderate
4- somewhat hard
5- hard
6-
7- very hard
8-
9-
10- very, very hard

مدت و تعداد جلسات ورزش

- ✓ با ۱۰ دقیقه یا مدت زمانی که فرد راحت است شروع شود و بعد به ازای هر هفته ۲ تا ٤ دقیقه اضافه شود تا به ۲۰ تا ٦۰ دقیقه برسد.
- ✓ حداقل سه بار در هفته ورزش در روز های غیر متوالی انجام گیرد.