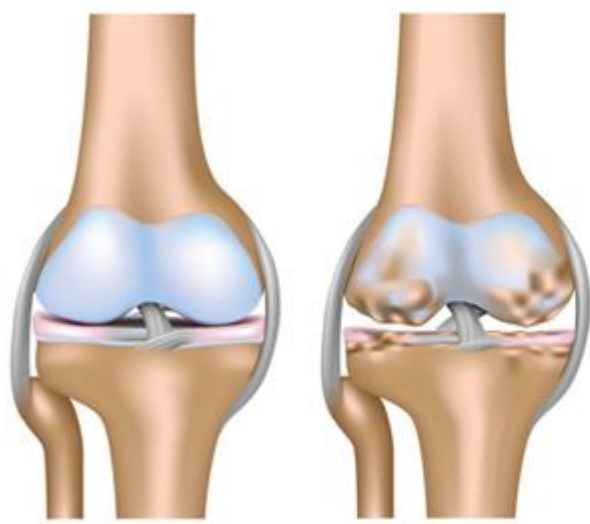


ورزش و پوکی استخوان

Exercise and osteoporosis



Healthy knee joint

Osteoarthritis



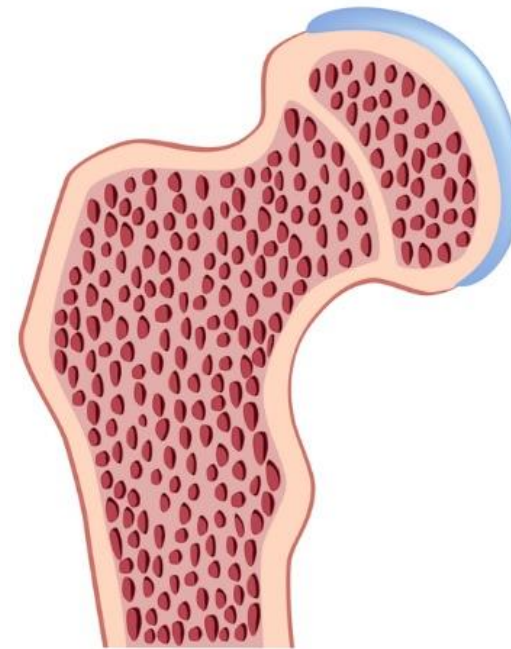
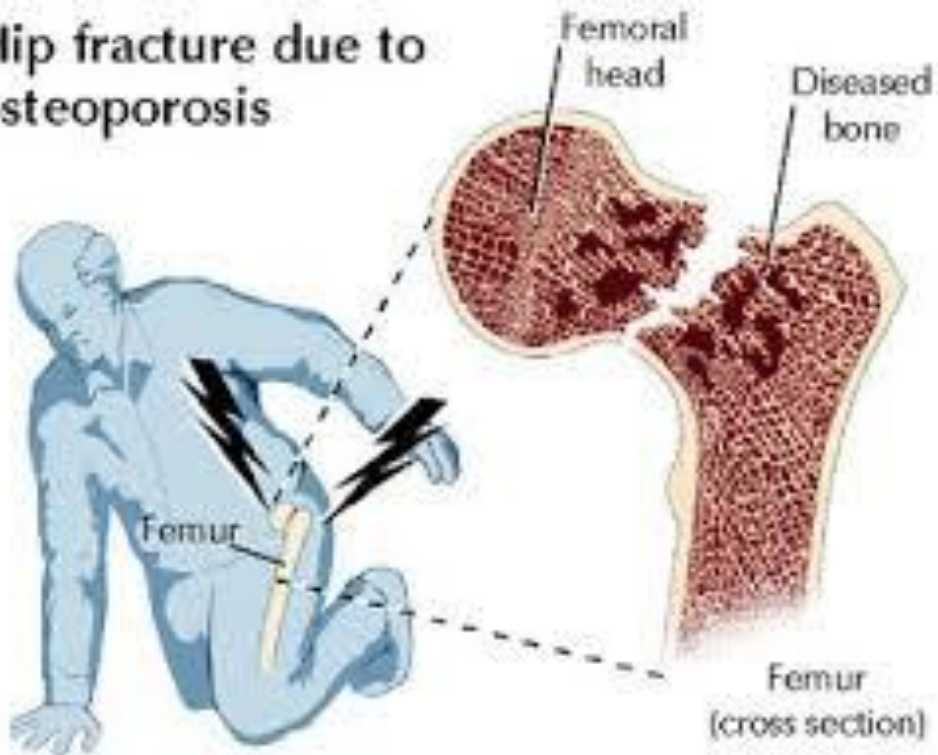
Healthy bone



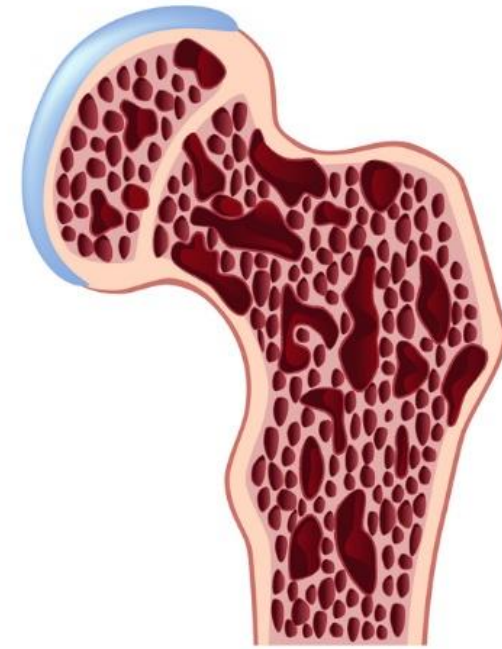
Osteoporotic bone

Osteoporosis

Hip fracture due to osteoporosis

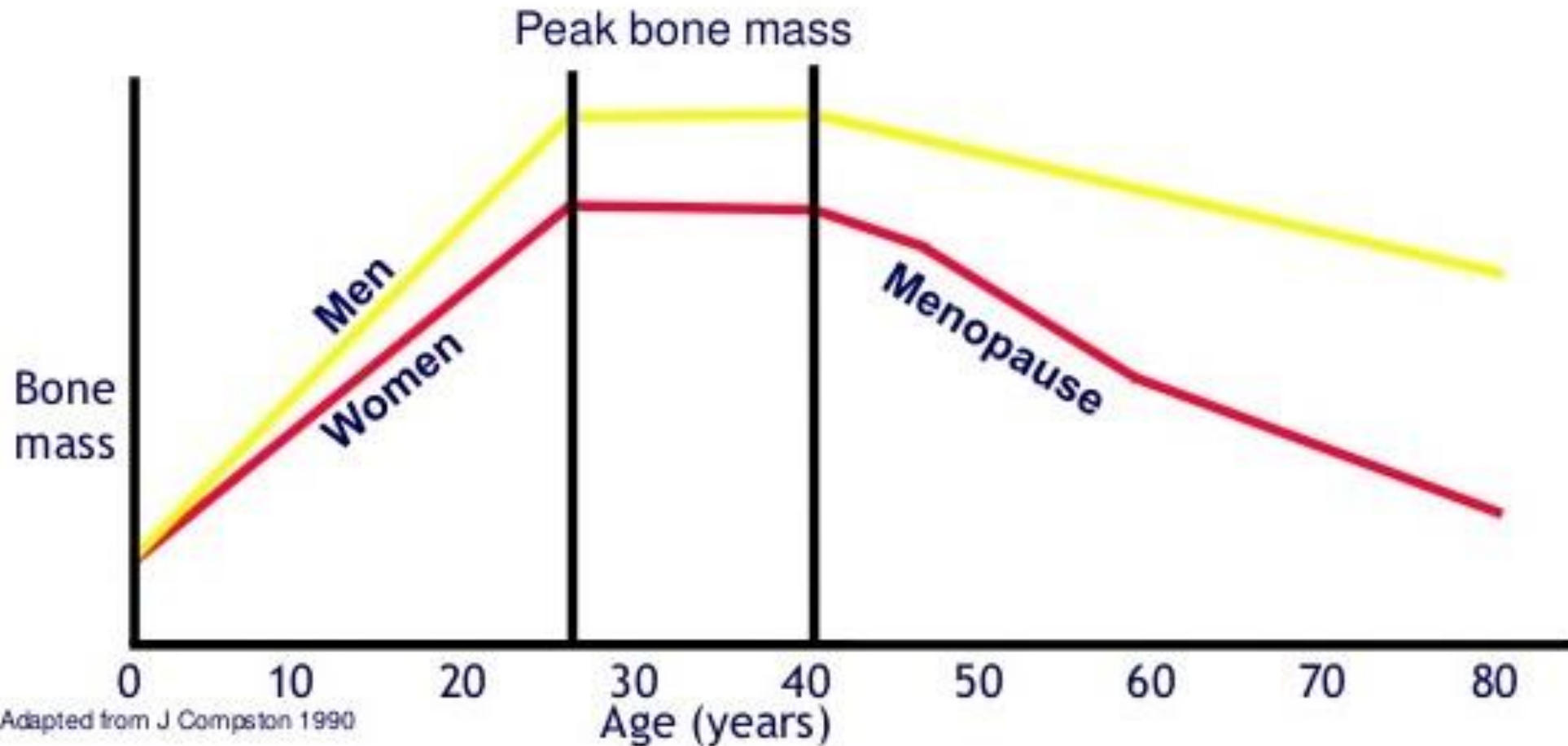


Healthy bone



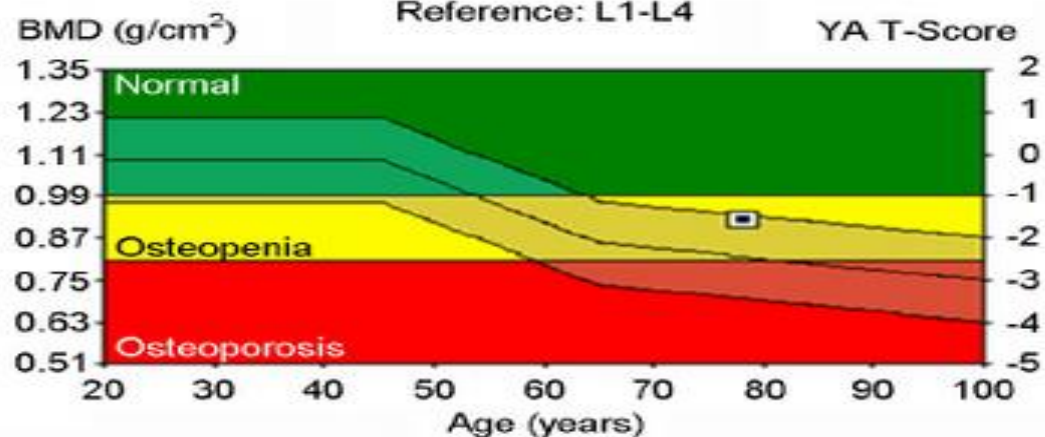
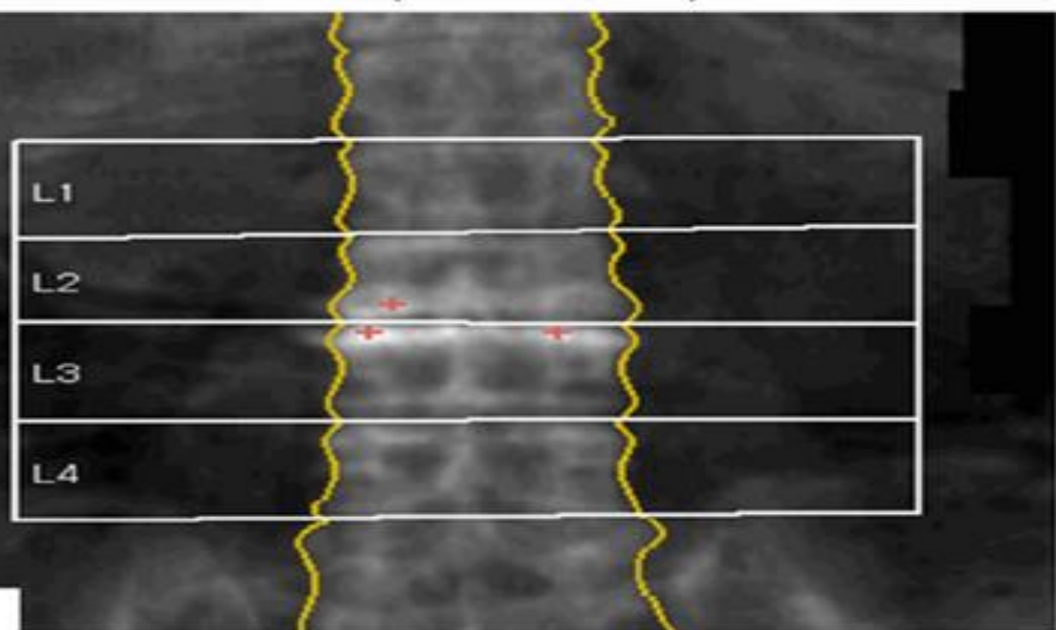
Osteoporosis

Changes in bone mass with age



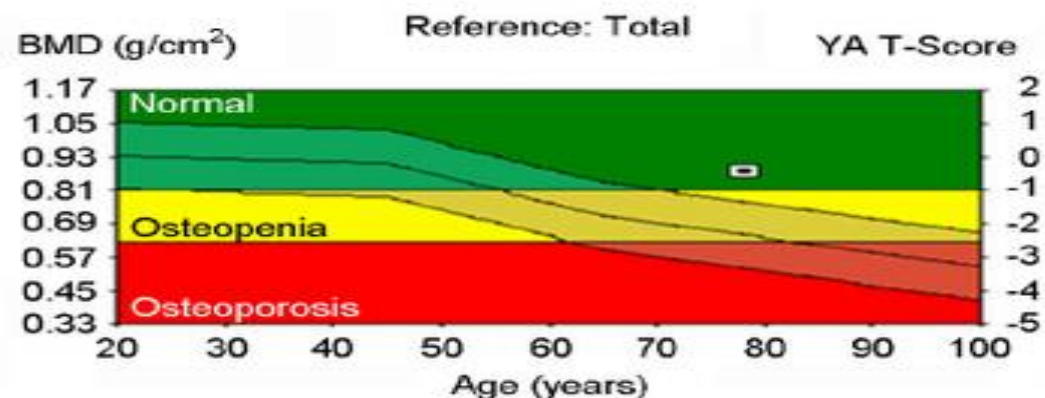
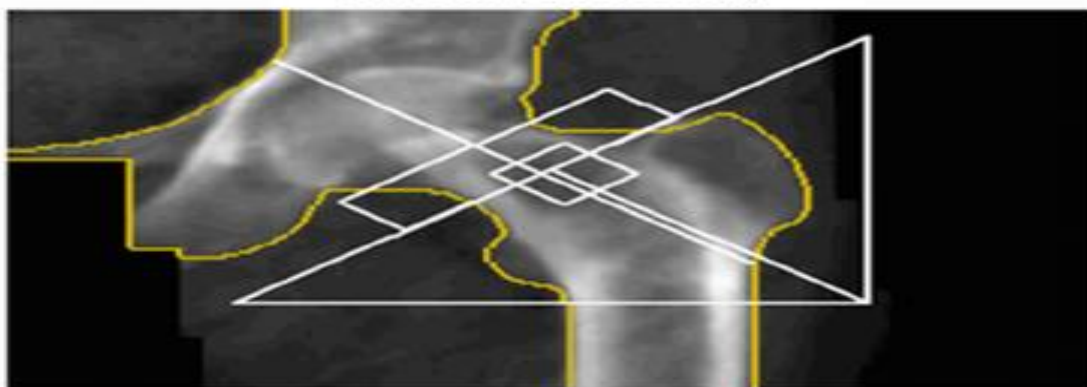


AP Spine Bone Density



Region	¹ BMD (g/cm ²)	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/cm ²)	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 $T\text{-score } x = (BMD - \text{peakBMD } x) / SD x$

(2) rearrange $BMD - \text{peakBMD } x = T\text{-score } x * SD x$

(3) rearrange $BMD = (T\text{-score } x * SD x) + \text{peakBMD } x$

(4) white female $T\text{-score WF} = (BMD - .858) / .120$

(5) substitute BMD from 3rd equation $T\text{-score WF} = ((T\text{-score } x * SD x) + \text{peakBMD } x - .858) / .120$

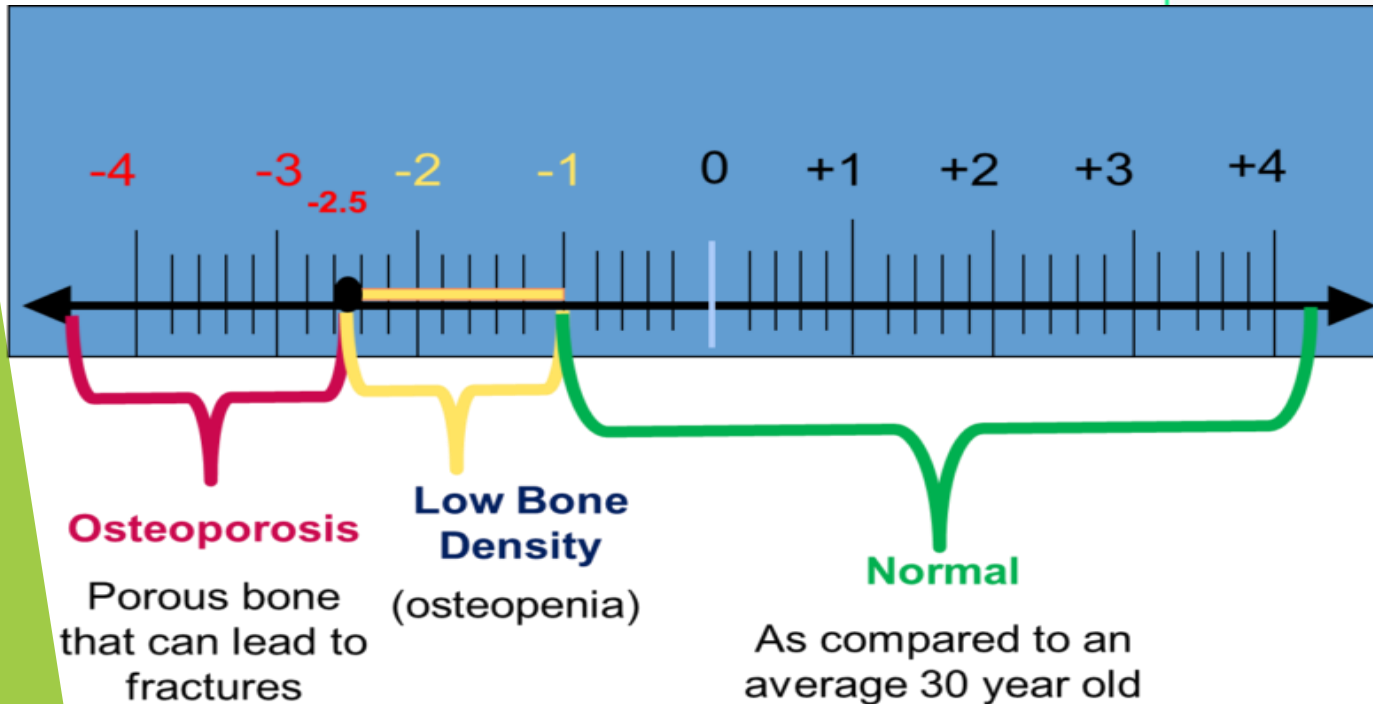
white male $= ((T\text{-score WM} * .137) + .934 - .858) / .120$

black female $= ((T\text{-score BF} * .133) + .950 - .858) / .120$

black male $= ((T\text{-score BM} * .168) + 1.074 - .858) / .120$

Hispanic female $= ((T\text{-score HF} * .111) + .874 - .858) / .120$

Hispanic male $= ((T\text{-score HM} * .137) + .982 - .858) / .120$



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.
- همچنین با انجام ورزش های تعادلی احتمال افتادن را می توان کاهش داد.

::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 menopause, 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 Optimize Performance



@jeukendrup

www.mysportscience.com



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



An alkaline diet does not prevent or cure cancer as claimed



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



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



The body regulates pH independent of the diet.

mysportscience



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



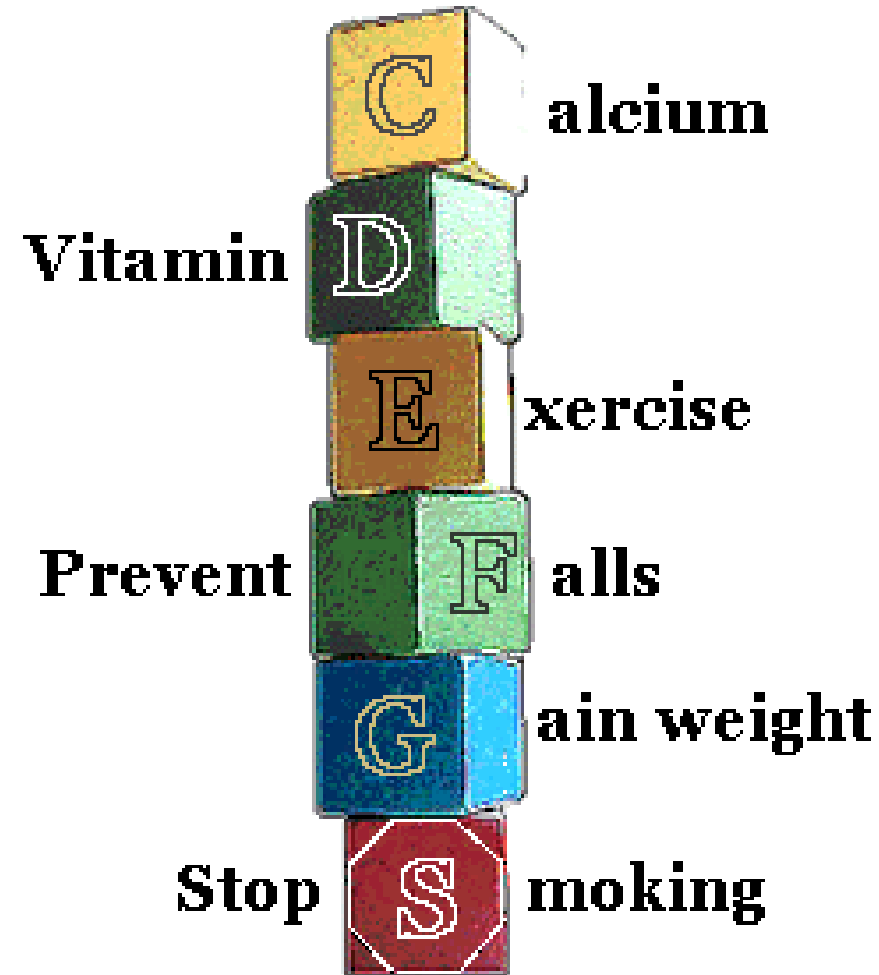
Bottomline.... It is a stubborn myth.

OSTEOPOROSIS RISK FACTORS



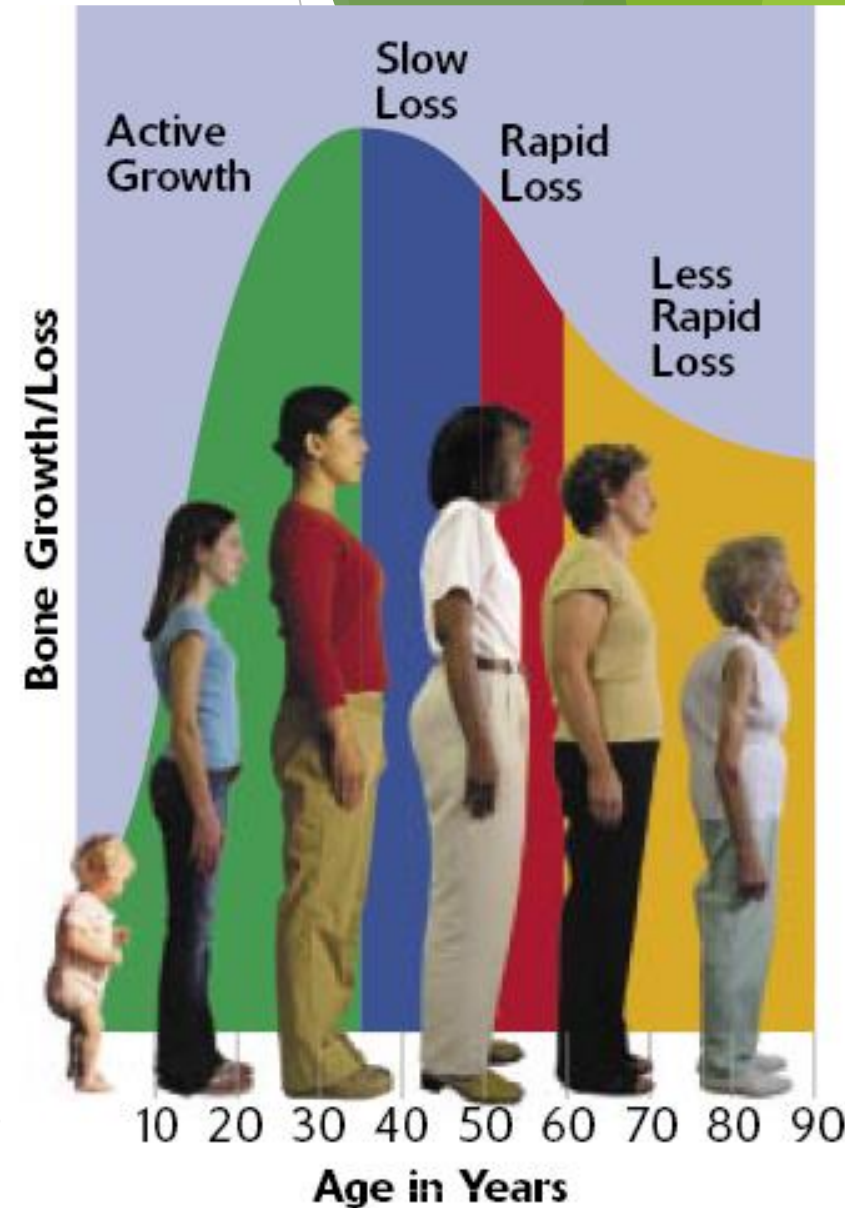
“Access” (leads to) Osteoporosis

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.

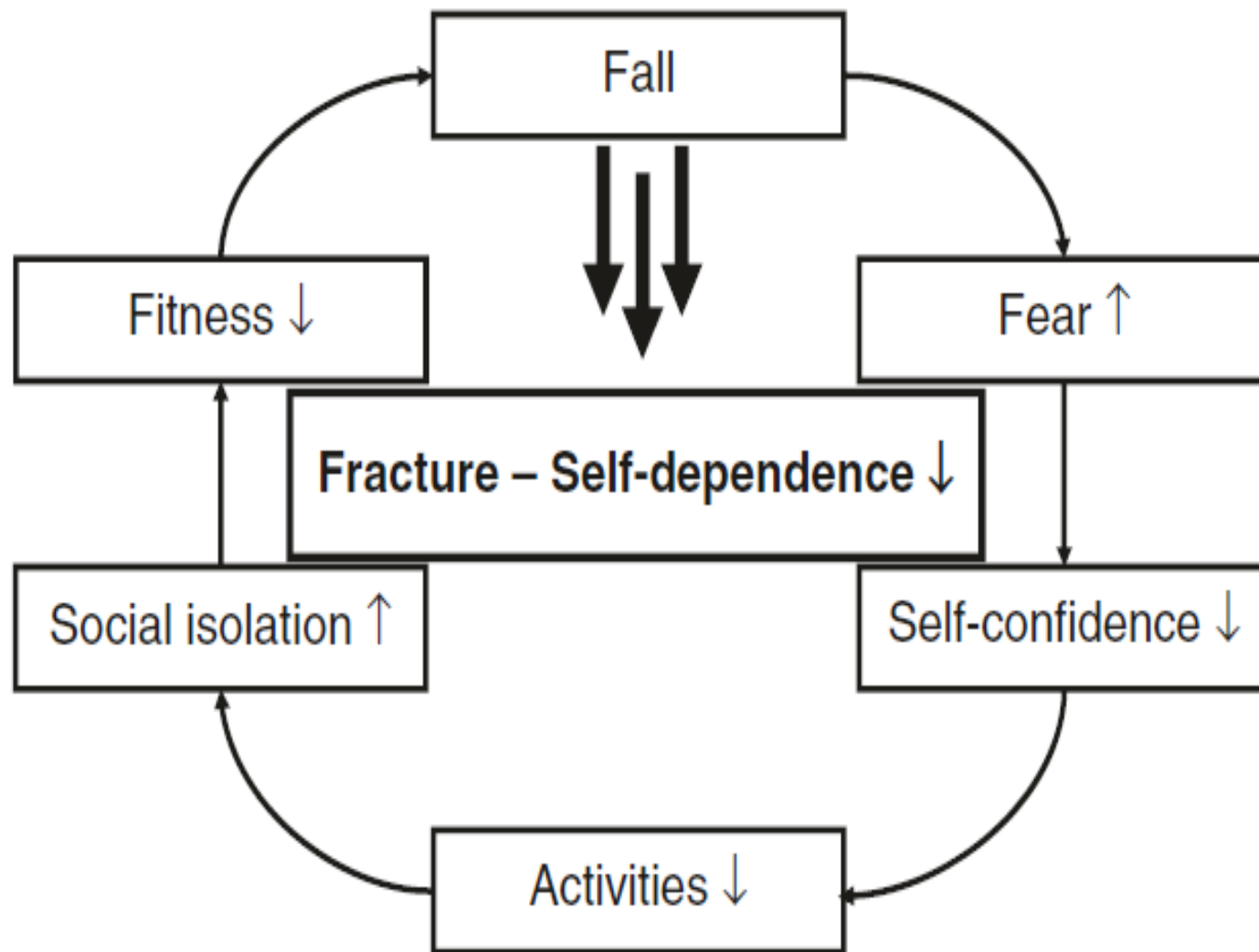


پیشگیری

- 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 ۴۳ 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

Extrinsic factors

Inappropriate footwear

Insufficient ambulatory aids

Environmental (i.e., poor illumination, uneven surface, 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

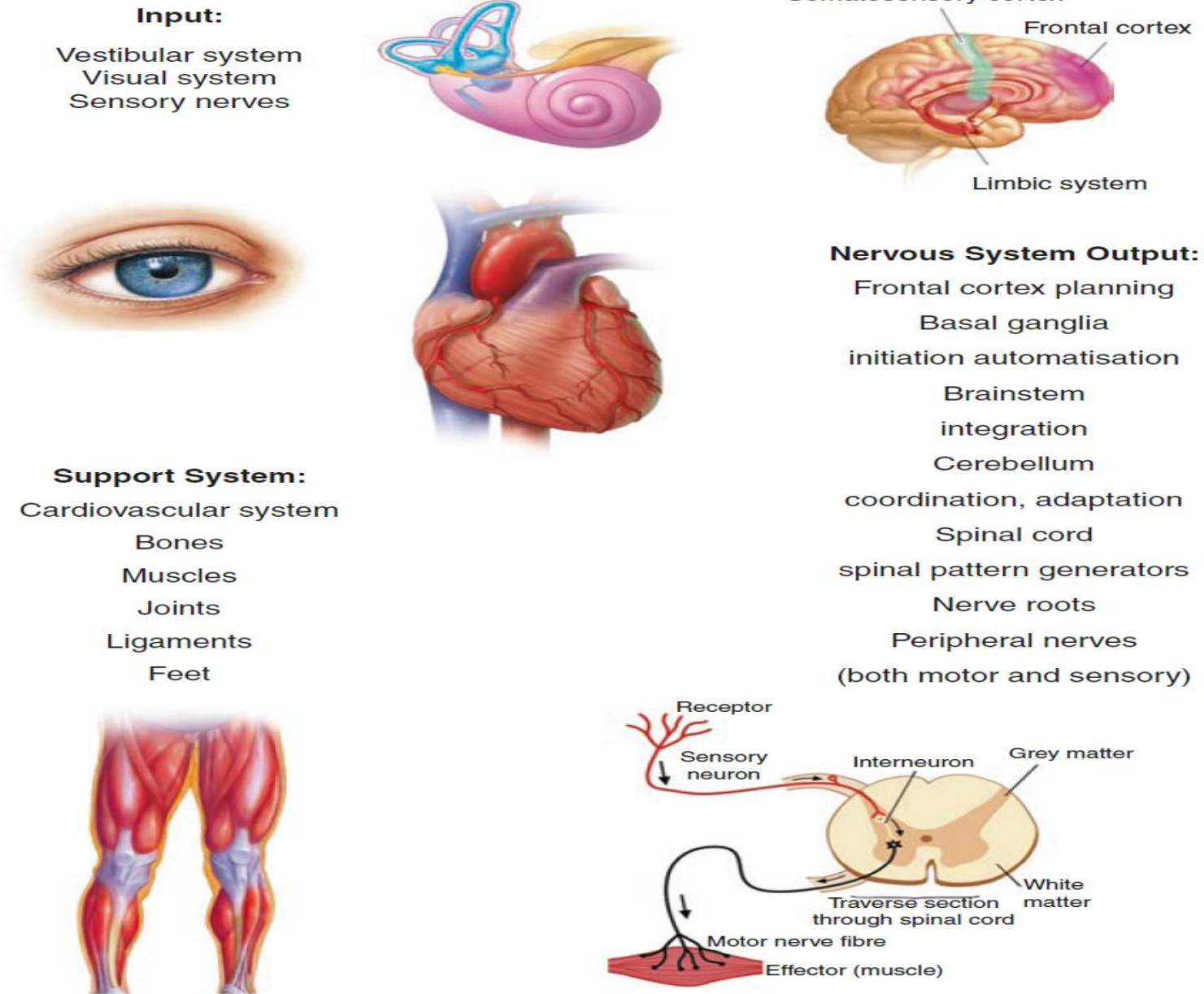


Fig. 15.7 This illustration indicates physiologic factors whose function contributes to normal locomotion

تغذيه



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

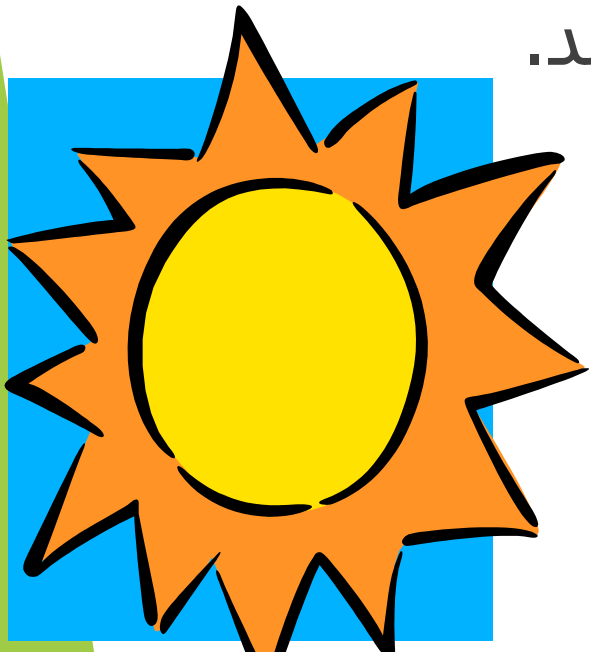
Food item, serving size	Calcium content (mg)
Milk (skim, 1%, 2% or whole), 1 cup	300
Low-fat yogurt, 6 oz. [\approx 180 g]	310
<i>Cheese</i>	
American, 1 oz. [\approx 30 g]	125
Cheddar, 1 oz. [\approx 30 g]	200
Swiss, 1 oz. [\approx 30 g]	270
Spinach (cooked), $\frac{1}{2}$ cup	120
Broccoli (cooked), $\frac{1}{2}$ cup	50
Kale (cooked), $\frac{1}{2}$ cup	90
Orange juice (calcium fortified), $\frac{1}{2}$ cup	250
Almonds, 1 oz. [\approx 30 g]	70
Salmon (canned with bones), 3 oz. [\approx 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 IU 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

Vitamin D necessary for calcium absorption



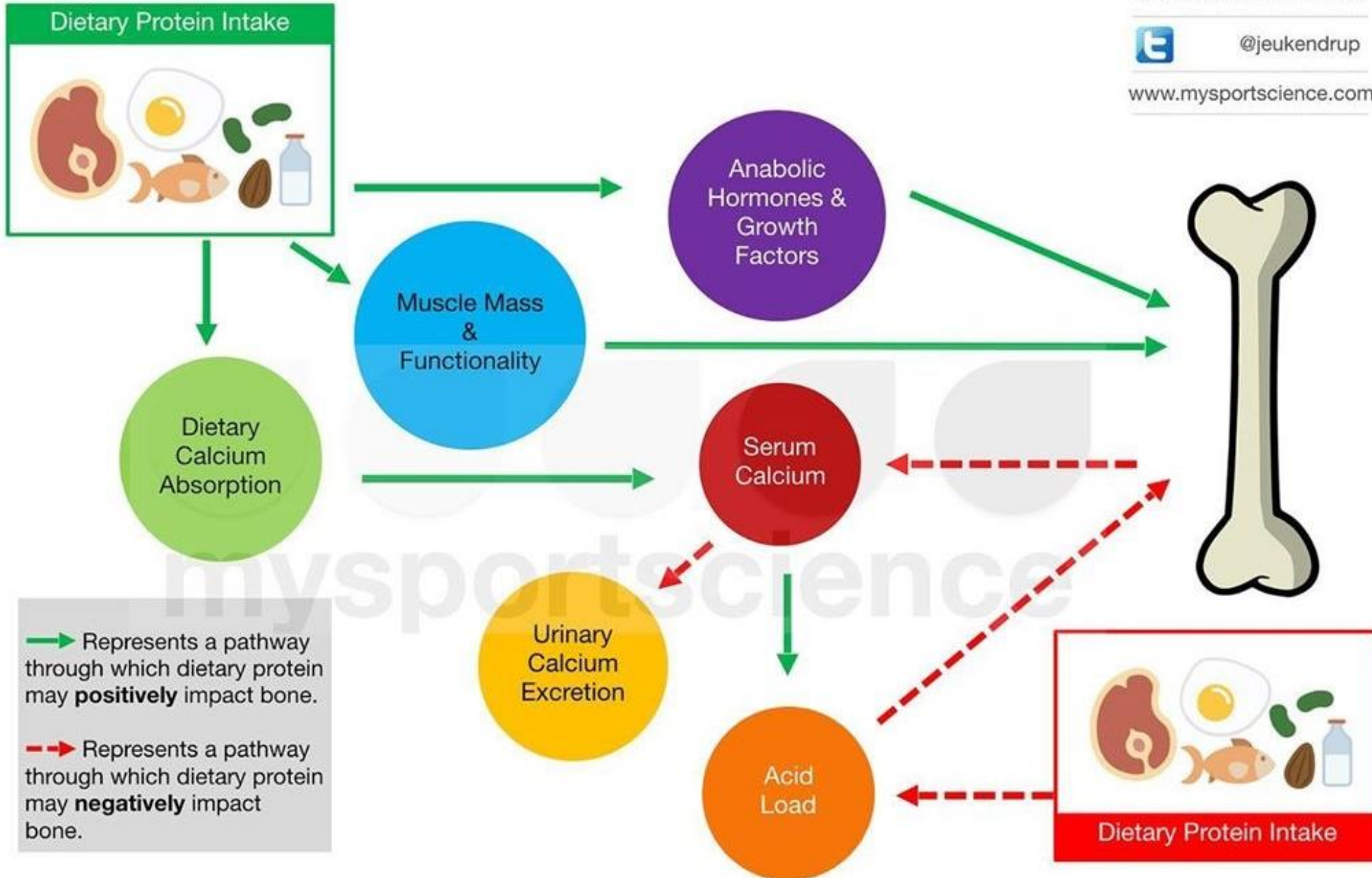
- ▶ 10-15 minutes exposure of hands, arms and face 2-3 times/week may be sufficient (depending on skin sensitivity).



▶ 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



الكل 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. [\approx 40 mL] of hard liquor, 12 oz. [\approx 350 mL] of beer, or 5 oz. [\approx 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].

Vitamin K Rich Foods



Avocado



Green Apples



Green Grapes



Honeydew Melon



Kiwi



Limes



Green Pears



Artichokes



Arugula



Asparagus



Broccoli



Broccoli Rabe



Brussels Sprouts



Napa Cabbage



Green Beans



Cabbage



Celery



Cucumber



Belgian Endive



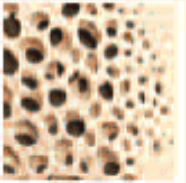
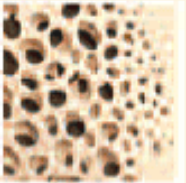
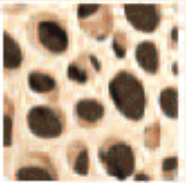
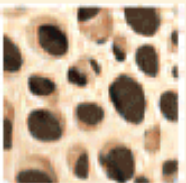

Kale

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.
- دوندگاران 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.

Relationship between physical activity score and age in 165 subjects aged 19 to 66 years

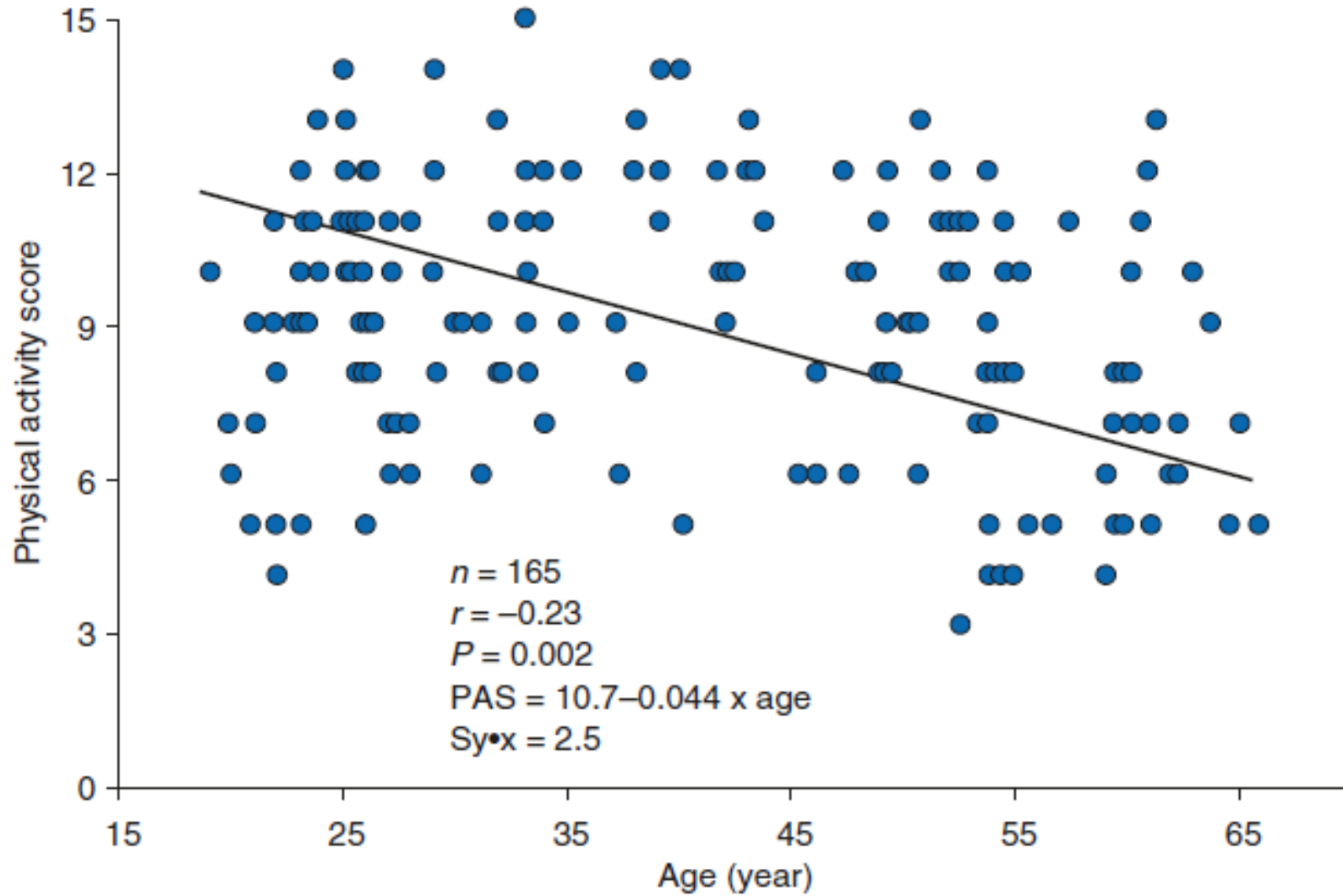


Fig. 1.4 Depicts reduction of physical activity level with increasing age in healthy population. From Sinaki M: Aging Clin Exp Res 10:249–262, 1998; used with permission.

Correlation of lumbar BMD with job-related physical activity score in 96 healthy Minnesota women of premenopausal age

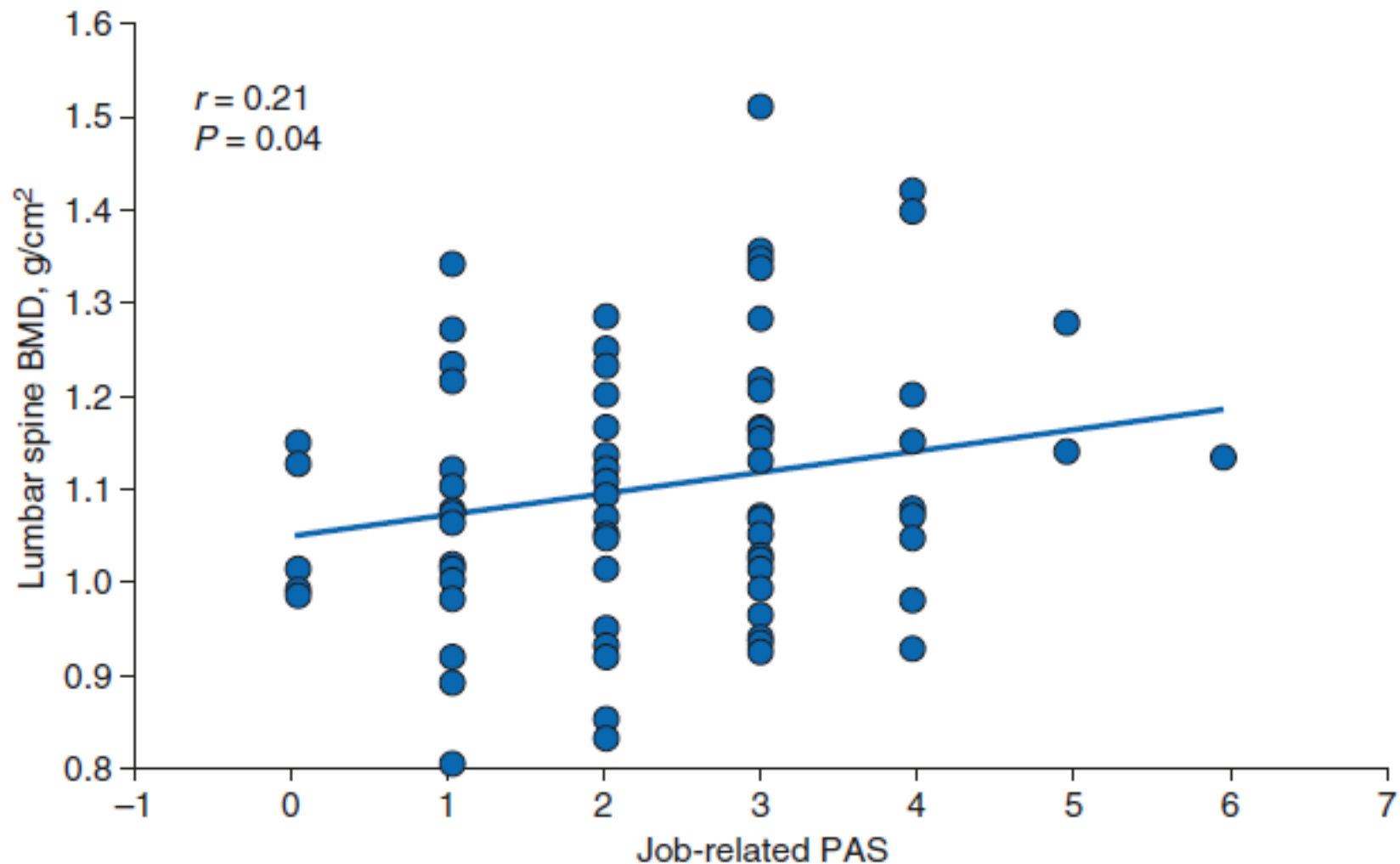


Fig. 1.5 Weight-bearing physical activity whether at job or otherwise could have positive effect on BMD of the spine. From Sinaki M, Fitzpatrick LA, Ritchie CK, Montesano A, Wahner HW. Site-Specificity of Bone Mineral Density and Muscle Strength in Women: Job-Related Physical Activity. *Am J Phys Med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

Significant correlation between BMD
of spine and strength of back extensors

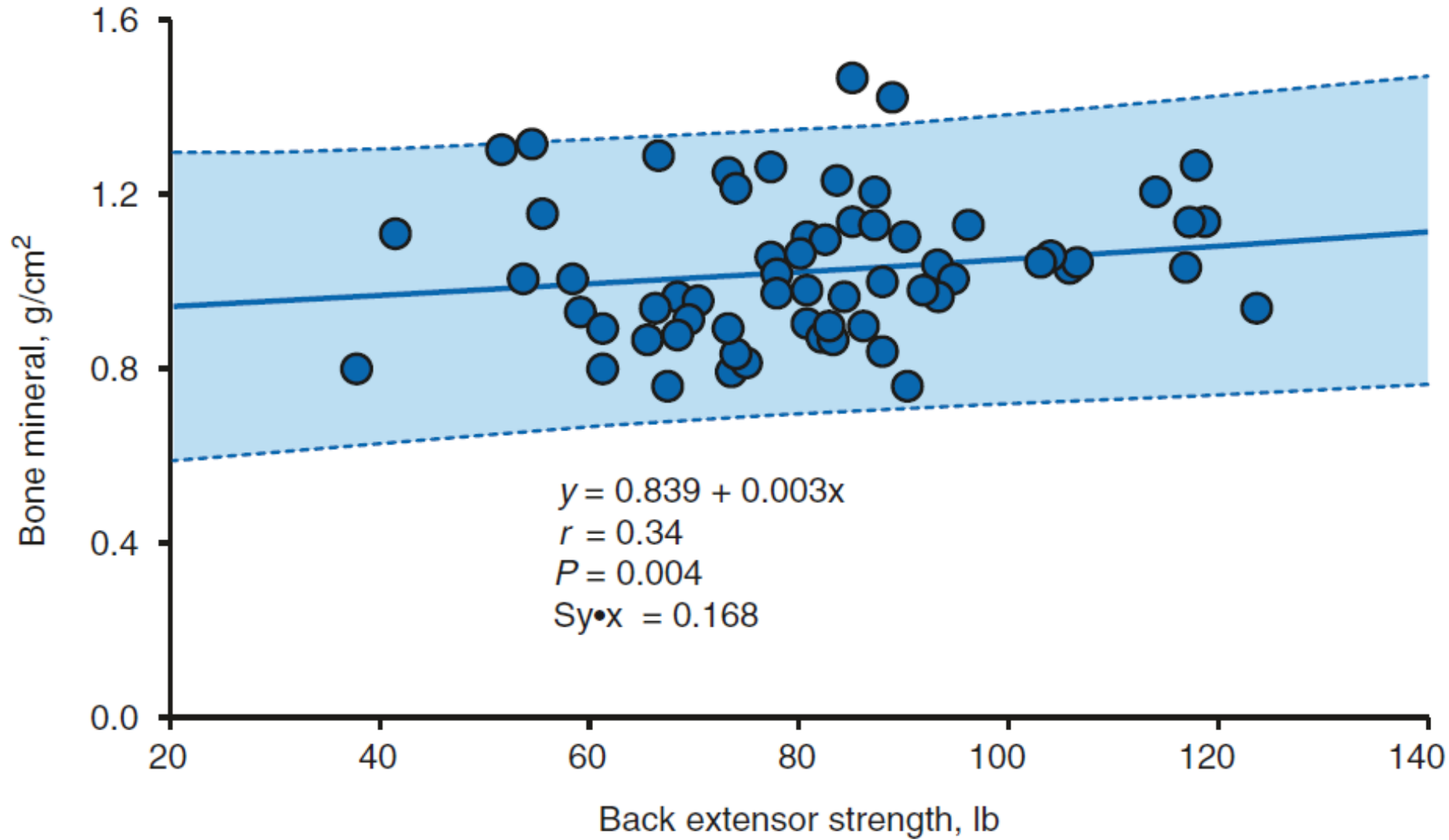


Fig. 7.6 Positive correlation of bone mineral density of the spine with back extensor strength. Data from Sinaki M, McPhee MC, Hodgson SF, Merritt JM, Offord KP. Mayo Clin Proc. 1986

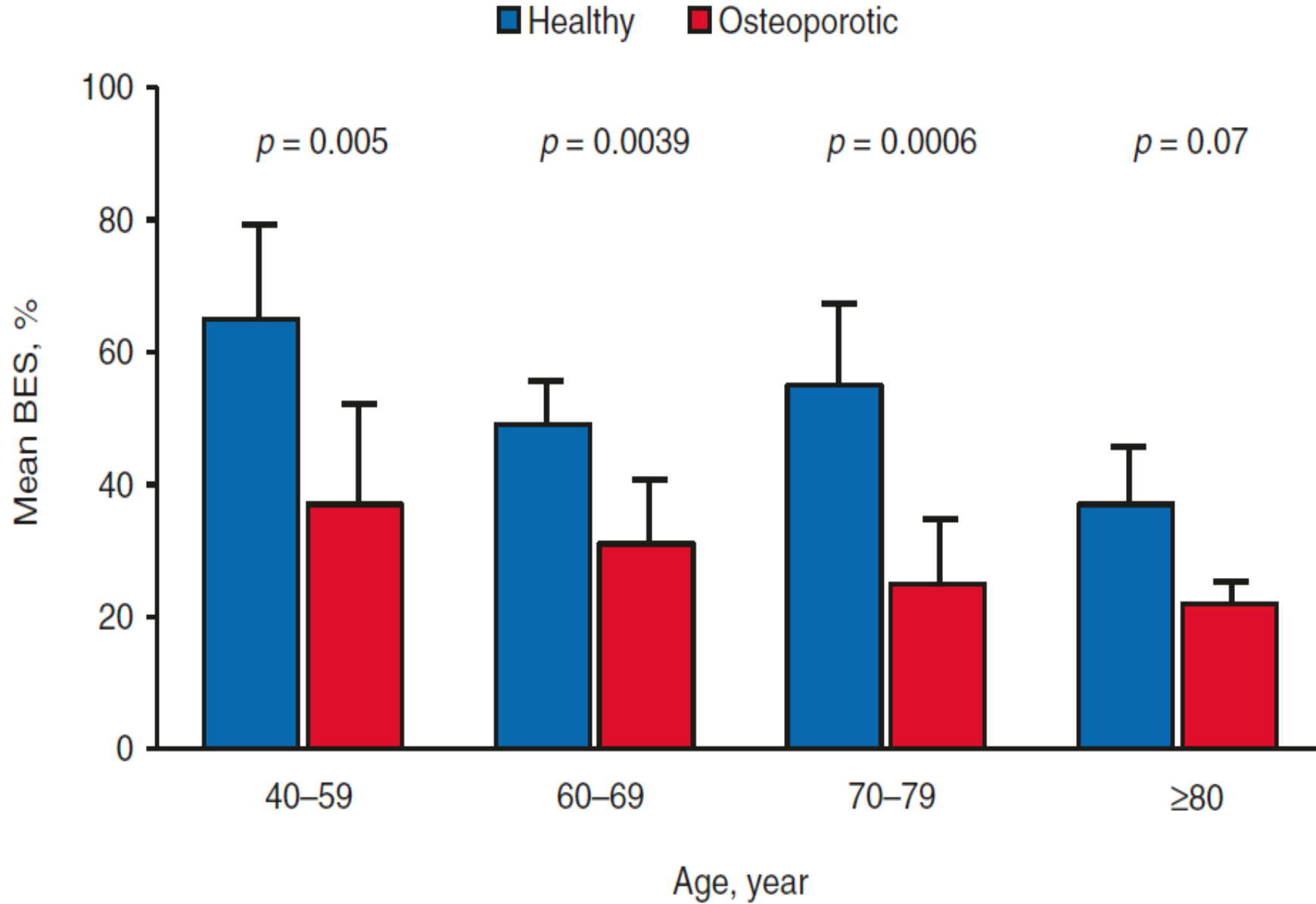


Fig. 7.12 Mean back extensor strength in healthy women and women with osteoporosis. Data from Sinaki M, Khosla S, Limburg PJ, Rogers JW. Muscle strength in osteoporotic versus normal women. *Osteoporos Int.* 1993;3:8-12.



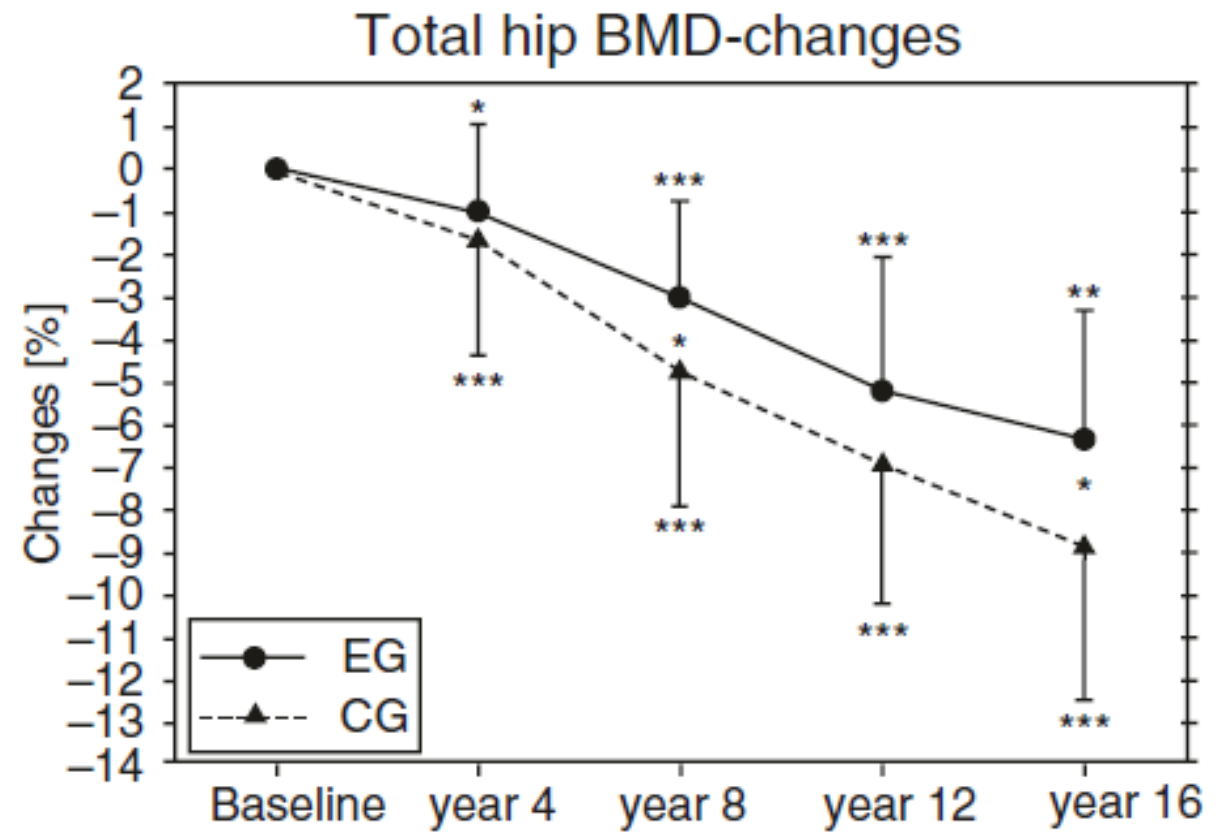
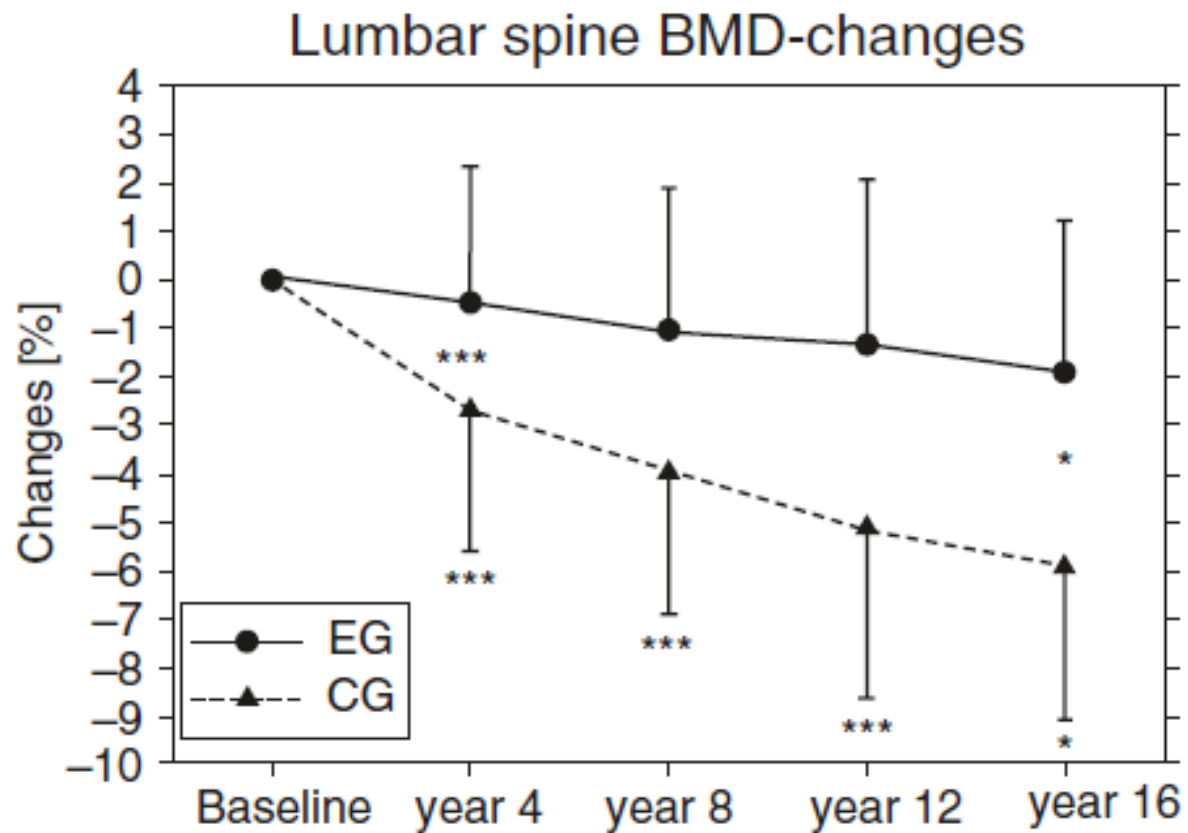


Fig. 6.2 BMD changes at LS and FN during the study course. Asterisks ($*p < 0.05$; $p < 0.001$) indicate either (top of the SD) significant different from the period before or (between the curves) significant group difference (EG vs. CG) for the corresponding period

► 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.

Incidence of new vertebral compression fractures

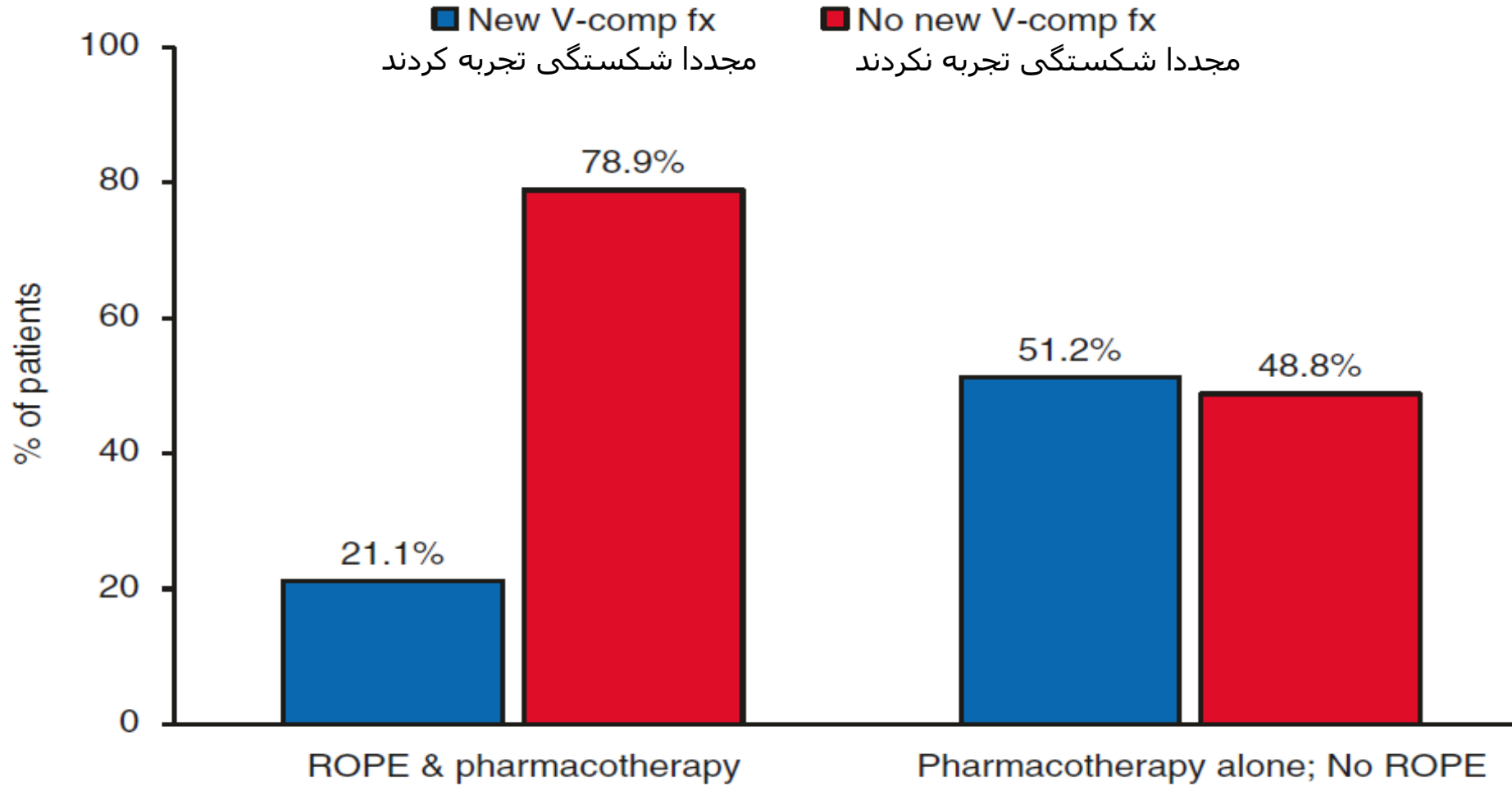


Fig. 7.10 Comparing women with osteoporosis who performed ROPE and pharmacotherapy versus those who used only pharmacotherapy. From Figueroa DAK, Sinaki M. Significant reduction of vertebral fractures: Comparison of rehabilitation of osteoporosis program-exercise (ROPE) versus No-ROPE, with or without 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.

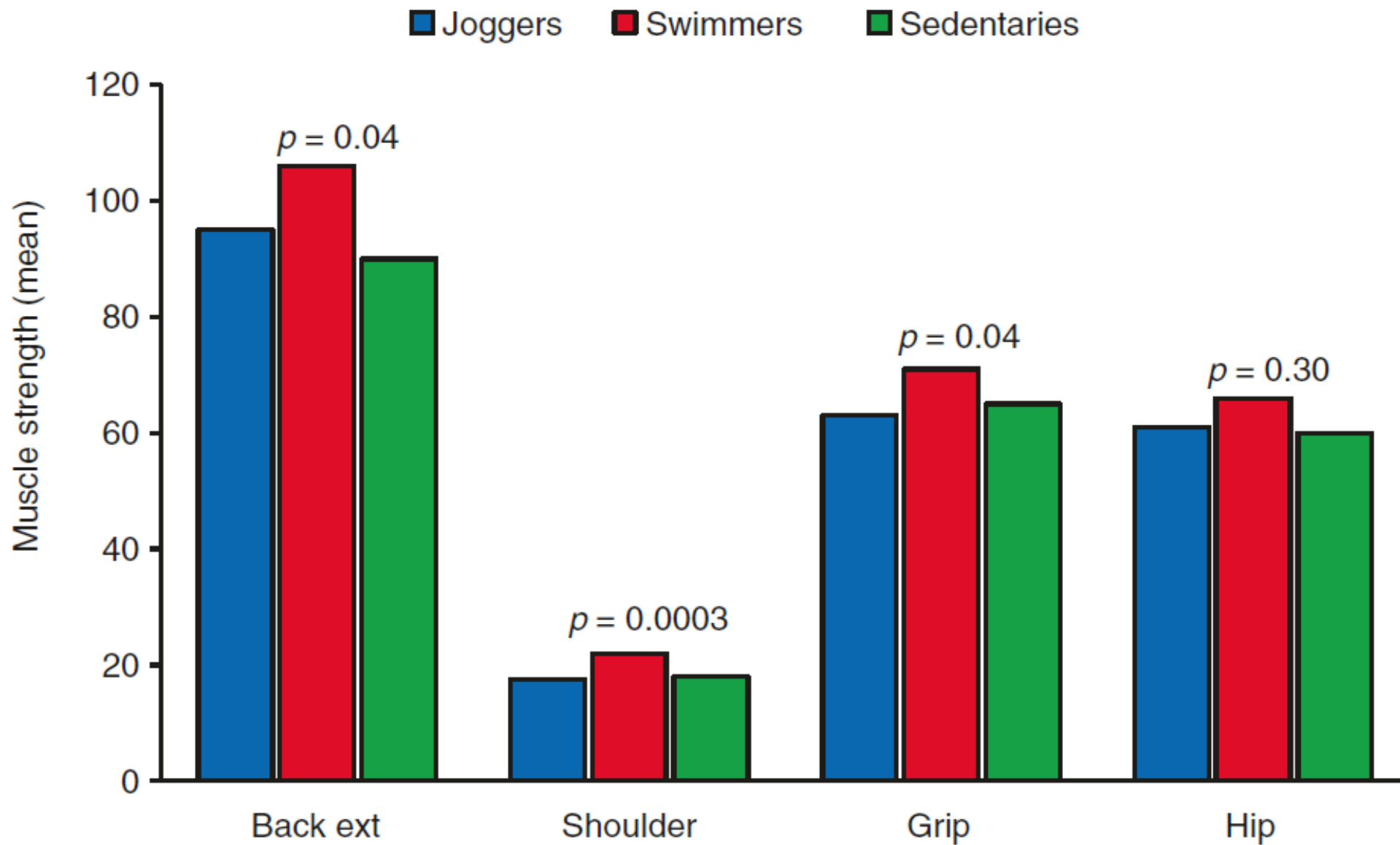
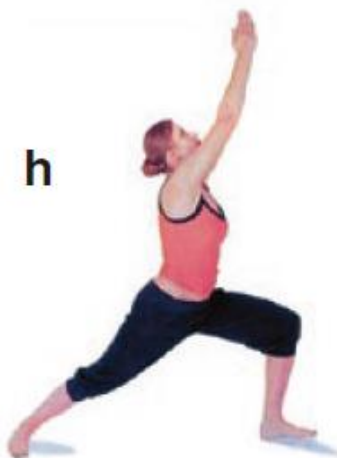


Fig. 7.1 Comparing muscle strength in three groups of female college students (swimmers, joggers, and sedentary). From Emslander HC, Sinaki M, Muhs JM, Chao EY, Wahner HW, Bryant SC, Riggs BL, Eastell R. Mayo Clin Proc. 1998; used with permission.

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

Common Yoga Position Exercises



تمرین روی سطوح ناپایدار



Comparing baseline and follow up X-rays of spine in osteoporosis : % of new vert Fx's in 3 groups of back exercise program

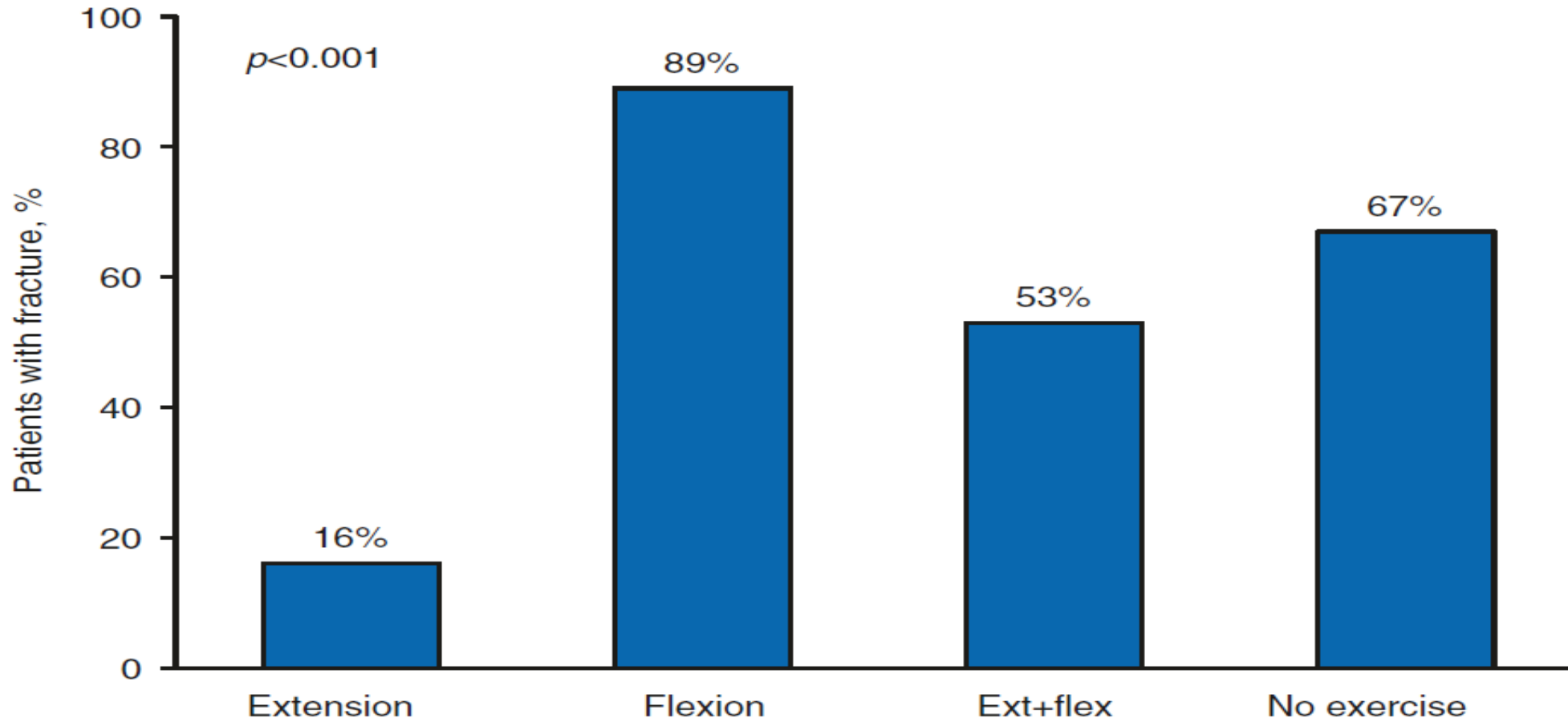


Fig. 7.2 Comparing baseline and follow-up X-rays of the spine in four groups of osteoporotic women after participation in therapeutic back exercises. Percentage of new vertebral fractures in spinal extension; spinal flexion combined with extension; spinal flexion only; and no exercise). y-Axis reflects 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 ۴ دقیقه اضافه شود تا به ۲۰ تا ۶۰ دقیقه برسد.
- ✓ حداقل سه بار در هفته ورزش در روزهای غیر متوالی انجام گیرد.