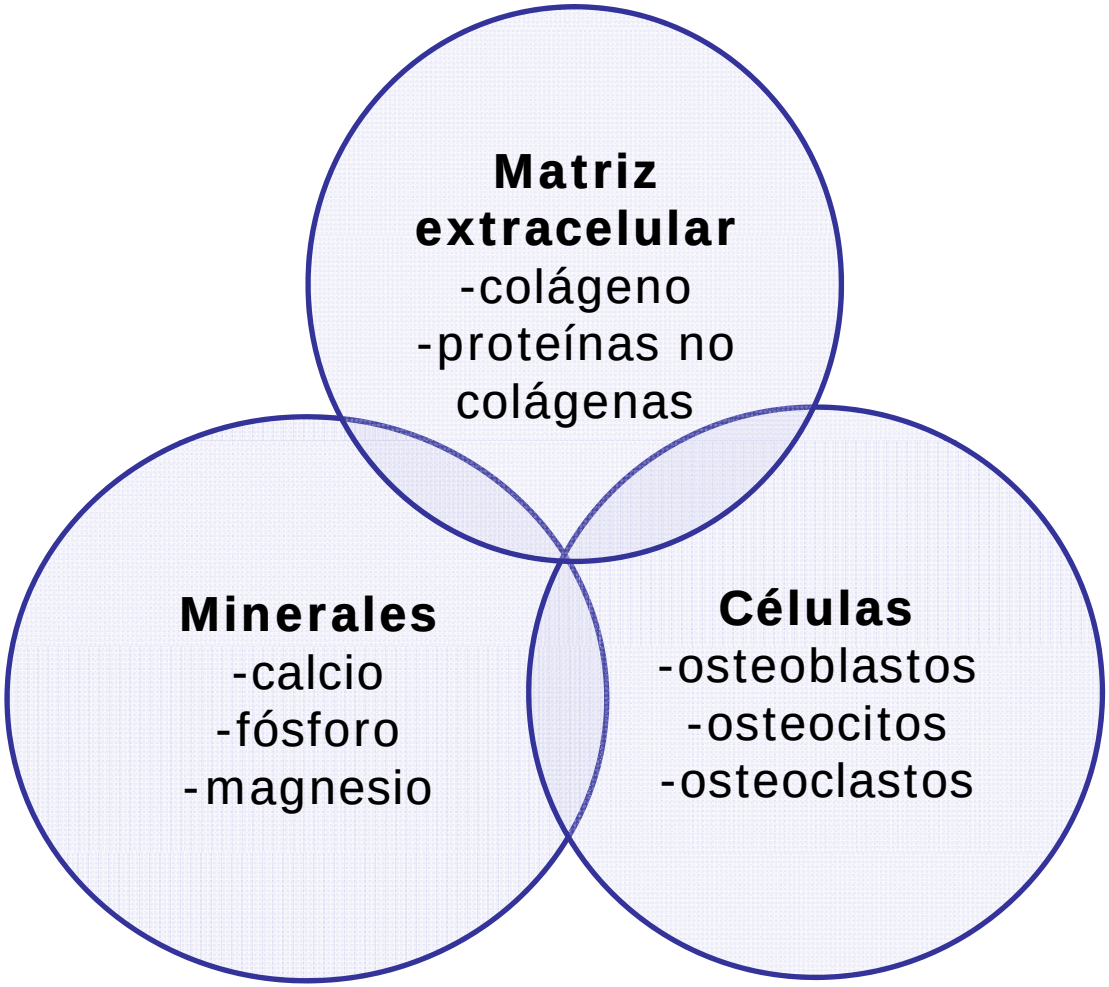
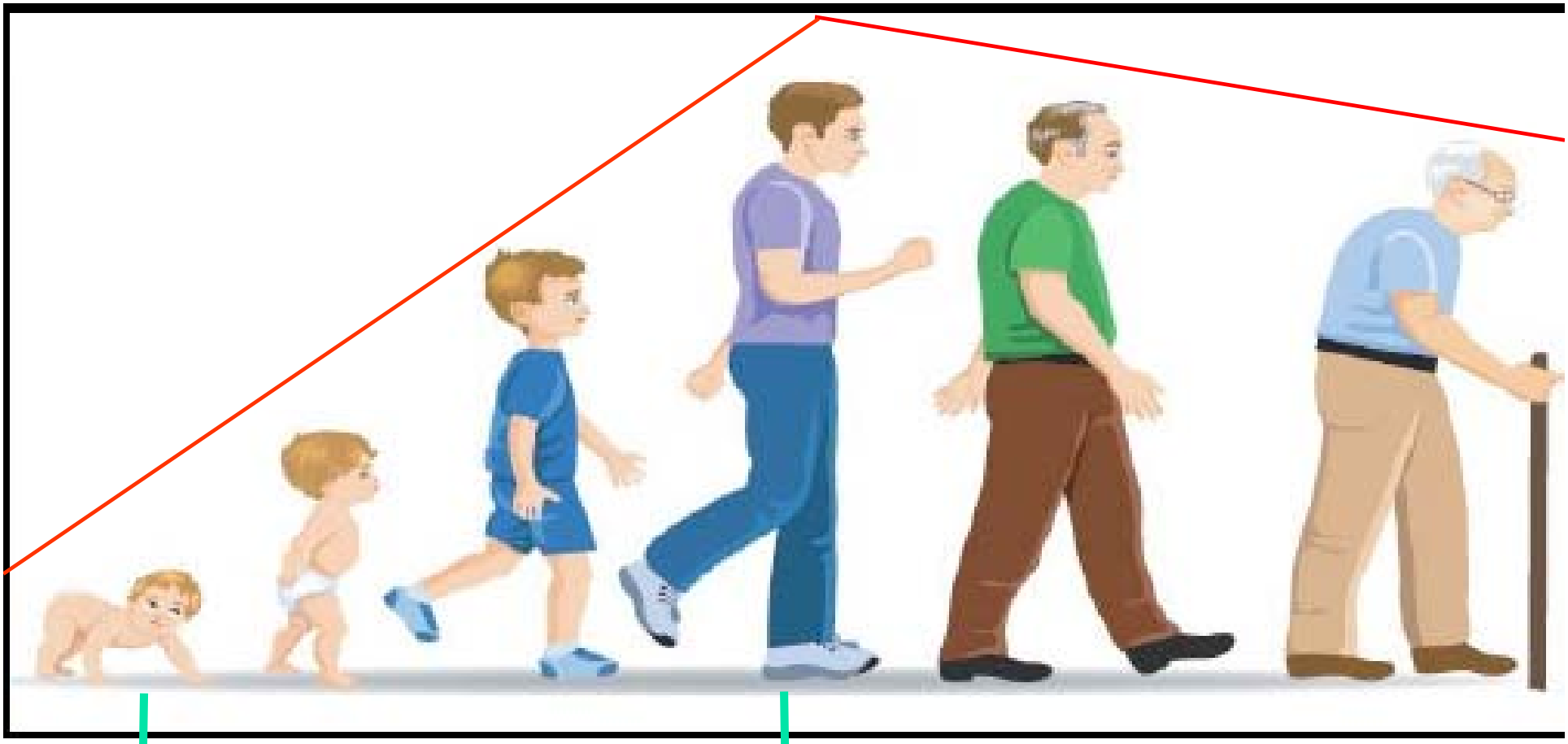
Salud ósea en la adolescencia

9° Congreso Argentino de Salud Integral del Adolescente
Sociedad Argentina de Pediatría
Buenos Aires, Agosto 2016

Dra. Gisela Viterbo

Hueso


Matriz extracelular
-colágeno
-proteínas no colágenas
Minerales
-calcio
-fósforo
-magnesio
Células
-osteoblastos
-osteocitos
-osteoclastos



Esqueleto 100 g
Calcio 30 g
Fósforo 15 g

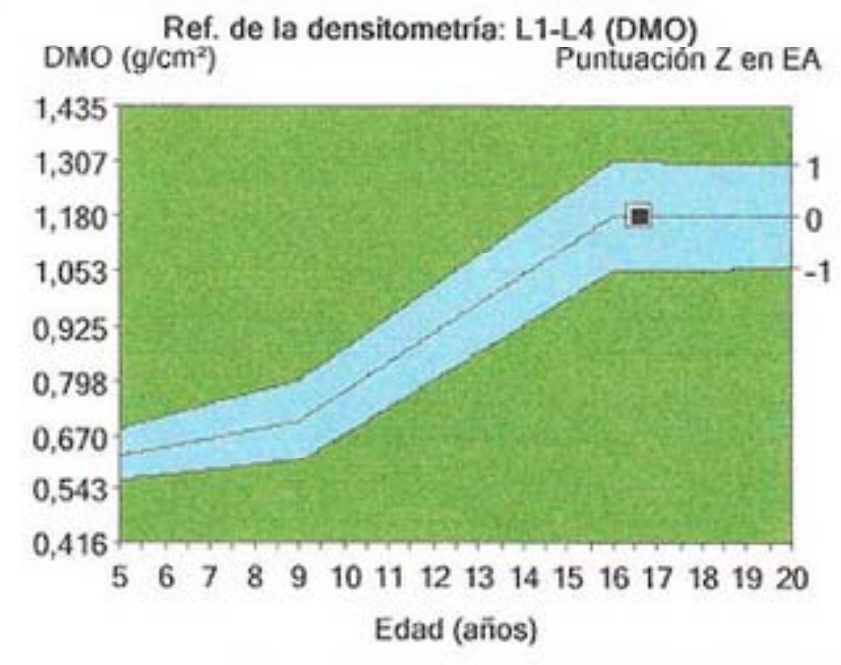
Esqueleto 3000 g
Calcio 1200 g
Fósforo 600 g

Fortaleza ósea

Factores cuantitativos:

Masa Ósea
- Densidad mineral ósea (DMO)
- Contenido mineral óseo (CMO)

Dual Energy X Ray absorptiometry (DXA)



Región	DMO [1] (g/cm²)	Ajust. a edad [2, 3] (%)	Ajust. a edad [2, 3] Puntuación Z
L1	1,110	98	-0,2
L2	1,187	99	-0,1
L3	1,203	100	0,0
L4	1,204	100	0,0
L1-L2	1,150	100	0,0
L1-L3	1,169	100	0,0
L1-L4	1,179	100	0,0
L2-L3	1,195	100	0,0
L2-L4	1,198	100	0,0
L3-L4	1,204	100	0,0

Fortaleza ósea

Factores cualitativos:

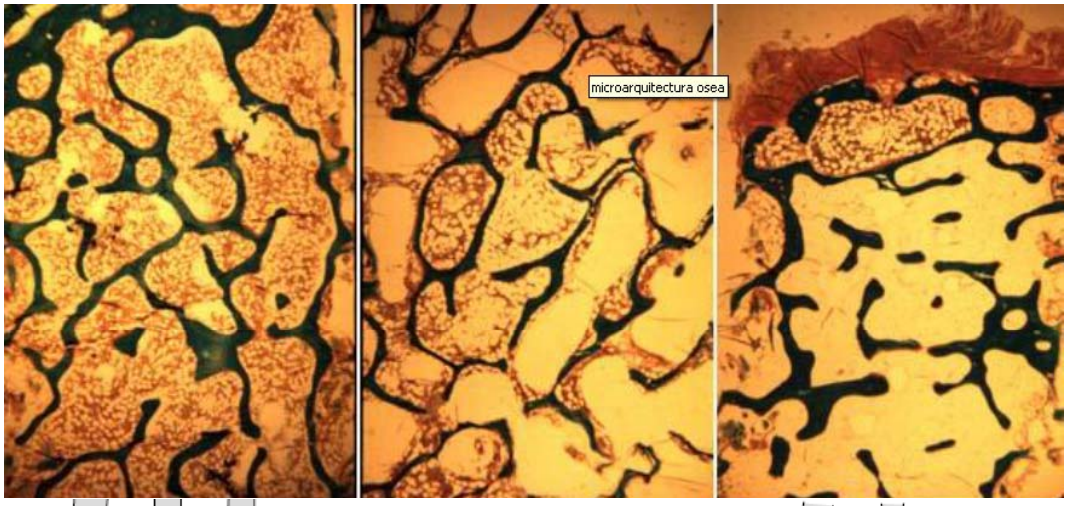
-Propiedad de los materiales

Colágeno

Mineralización

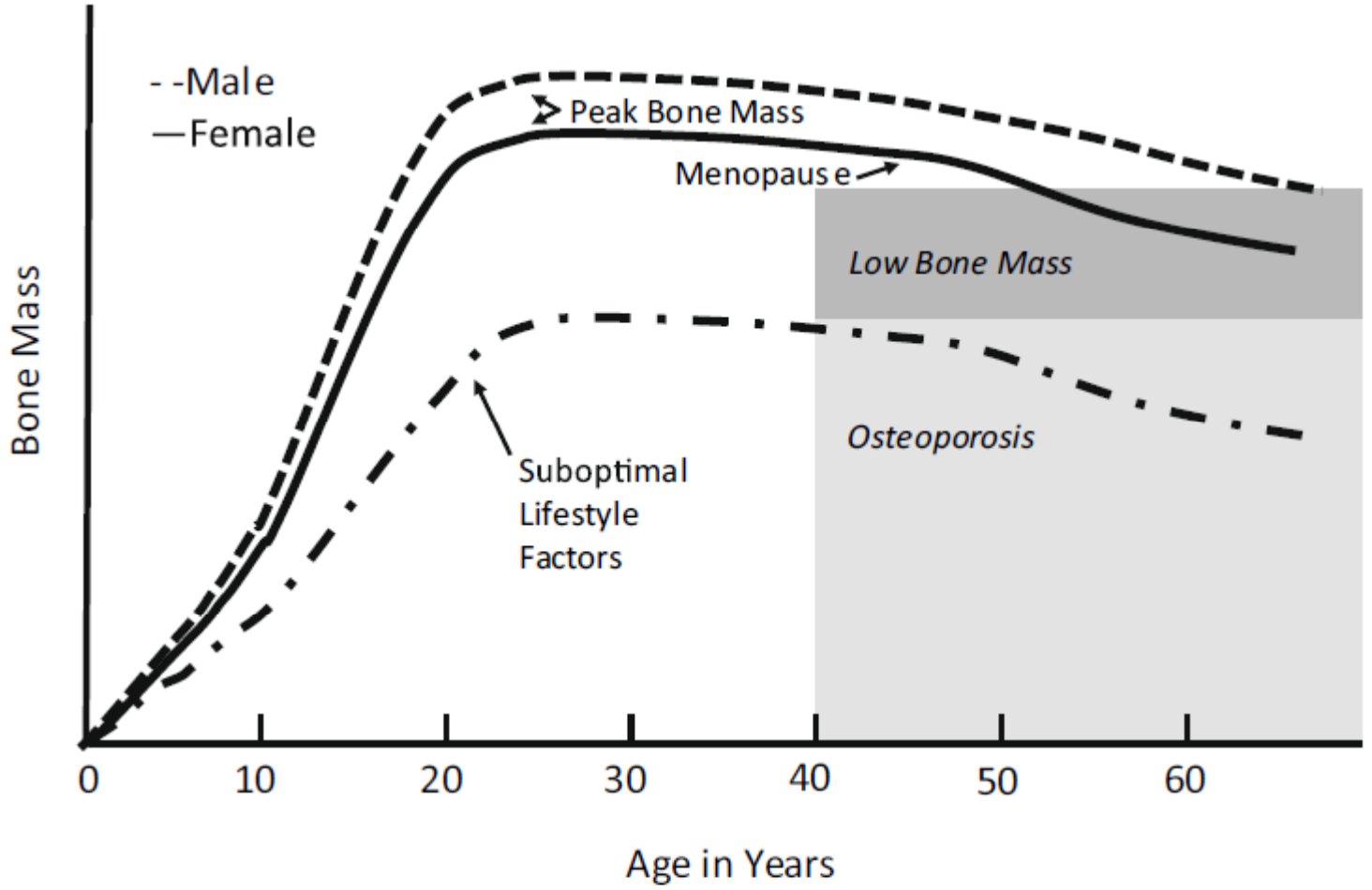
-Microarquitectura

-Macroarquitectura



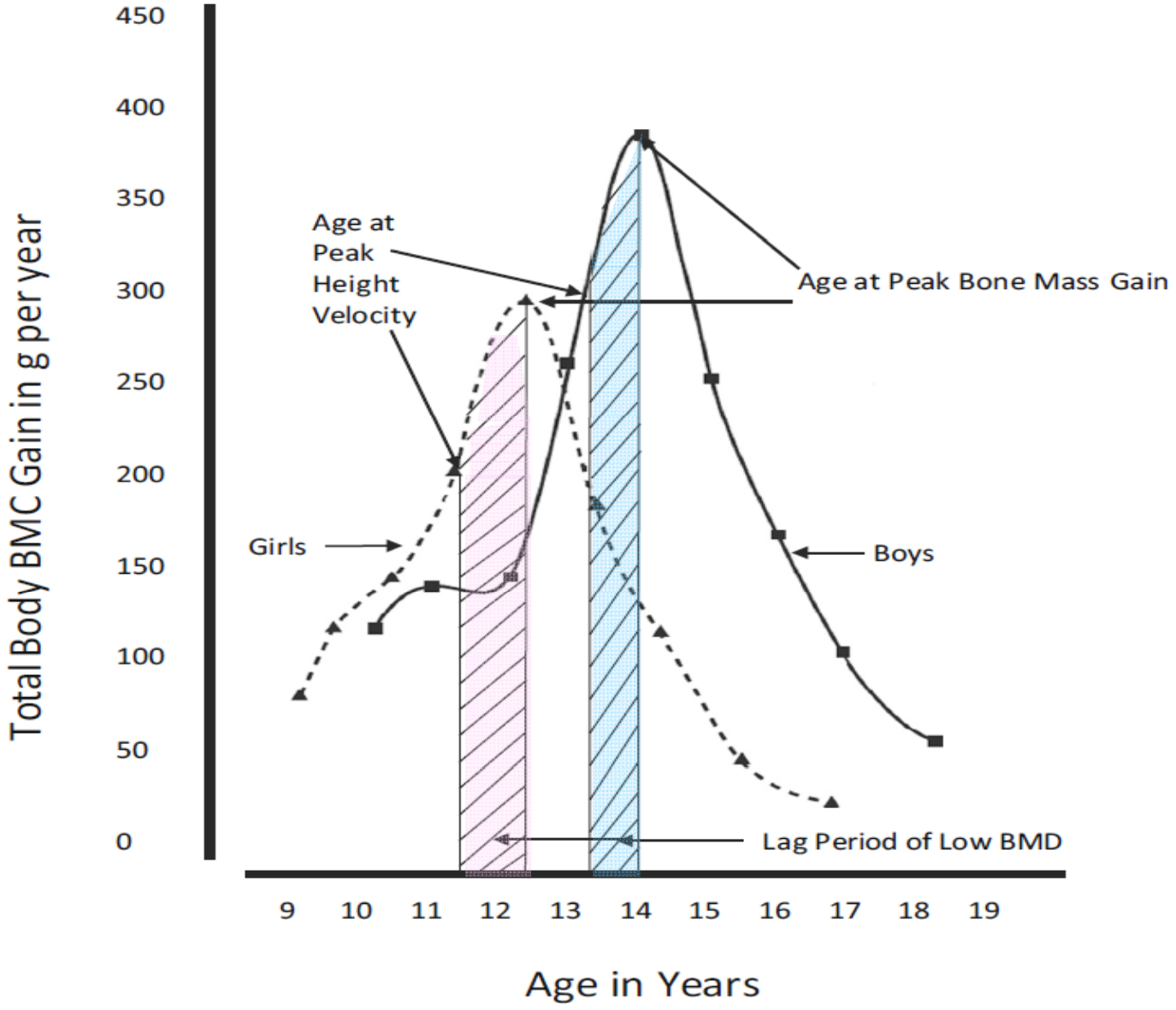
Pico de masa ósea (PMO)

Máxima cantidad de tejido óseo que se adquiere en el esqueleto al finalizar el crecimiento



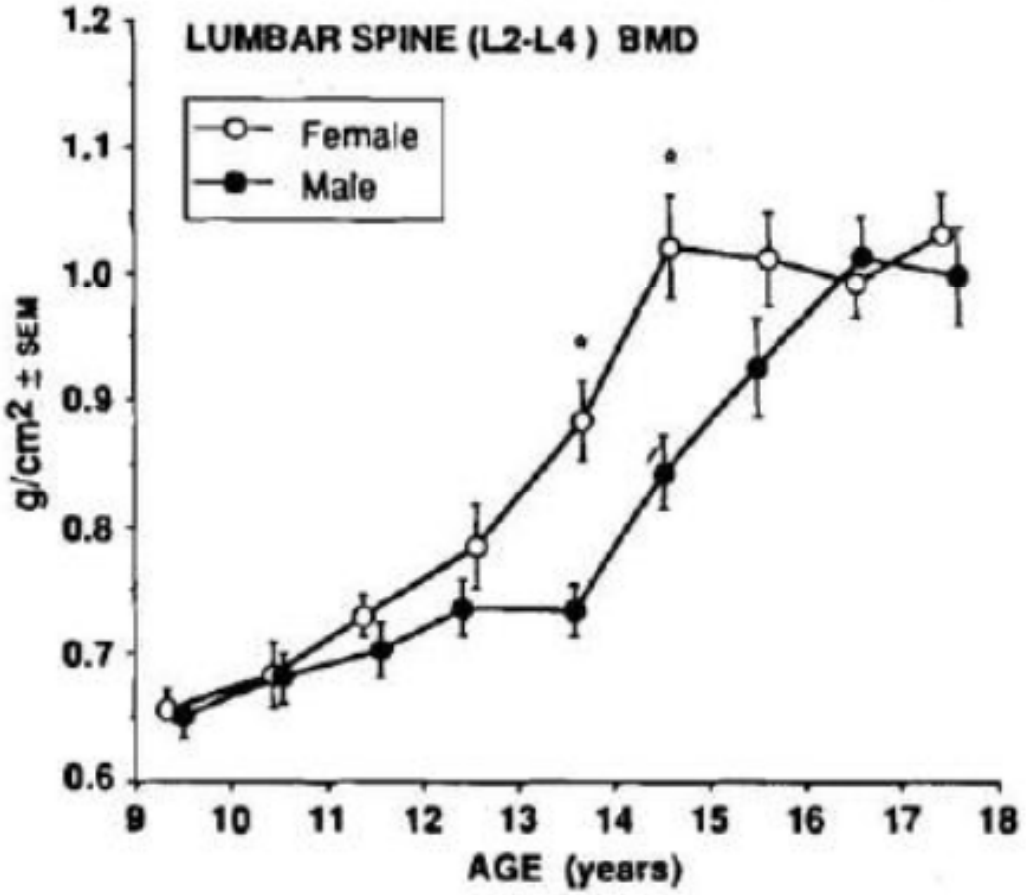
Osteoporos Int (2016) 27: 1281-1386

Ganancia CMO



Weaver C; Gordon, C; et al.Osteoporos Int (2016) 27: 1281-1386

DMO según edad y sexo

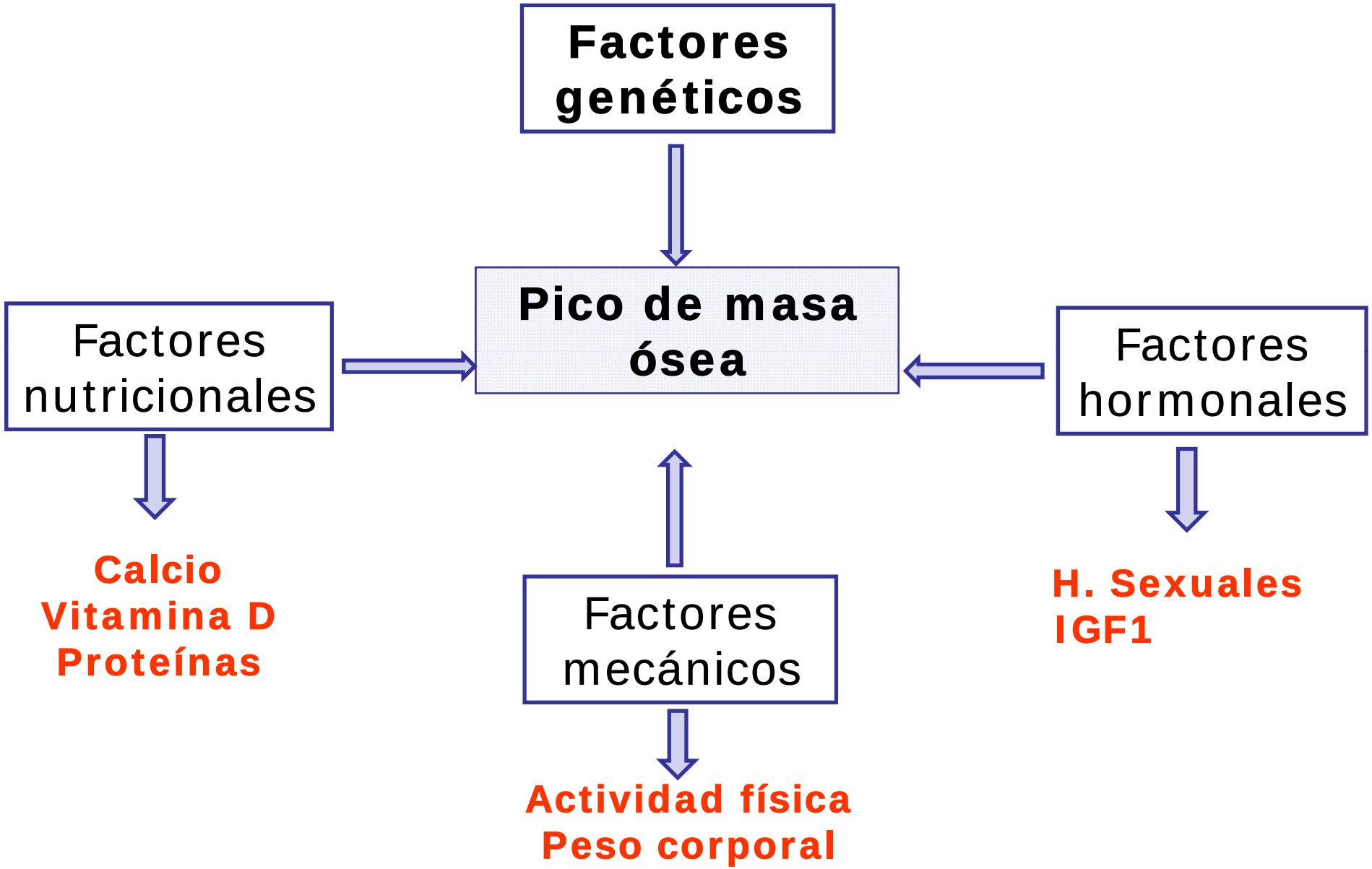


A los 18 años mujeres y varones adquirieron el 90% de la MO adulta

Las mujeres no ganan MO luego de 2.5 años postmenarca

Bonjour, JCEM 1991

Determinantes del PMO



Intervención

1) **Prevención Primaria:** optimizar salud ósea en adolescentes sanos

2) **Prevención Secundaria:** identificar grupos en riesgo

3) **Prevención Terciaria:** mejorar la MO en poblaciones de riesgo

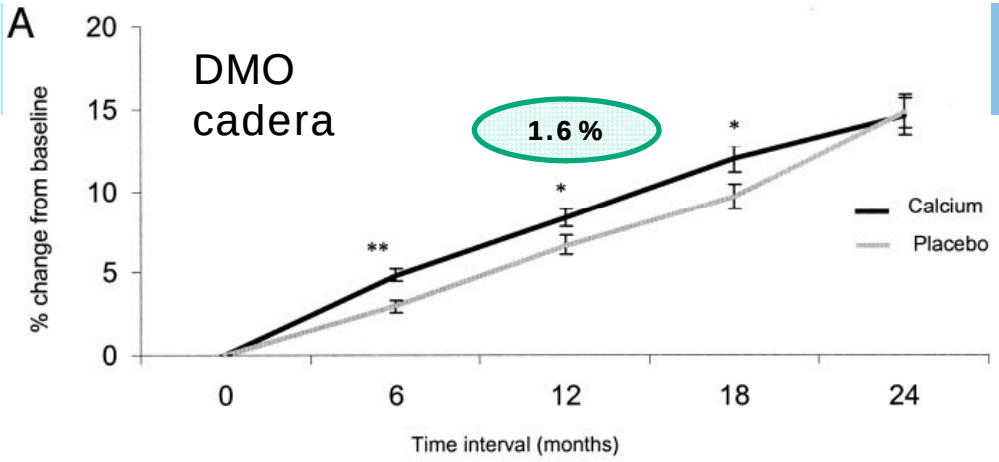
Determinantes del PMO

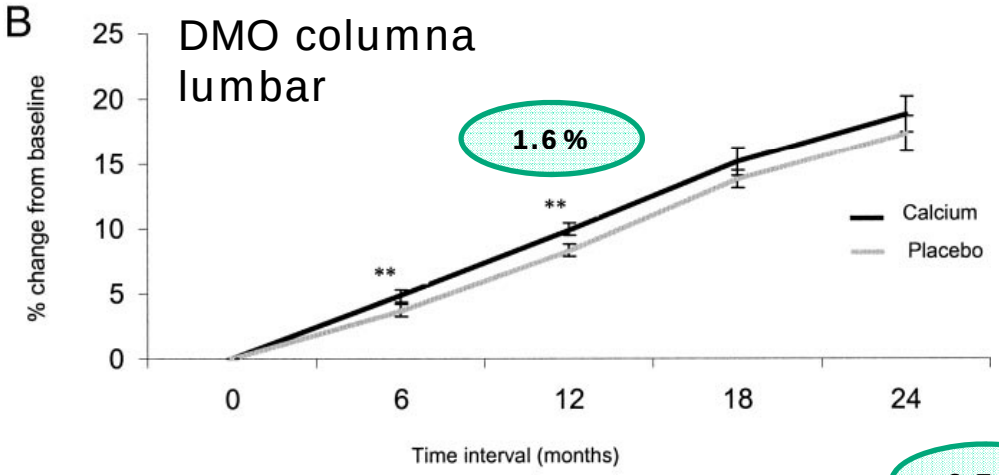
Lifestyle Factor	Grade
Macronutrients	
Fat	D
Protein	C
Micronutrients	
Calcium	A
Vitamin D	B
Micronutrients other than calcium and vitamin D	D
Food Patterns	
Dairy	B
Fiber	C
Fruits and vegetables	C
Detriment of cola and caffeinated beverages	C
Adolescent Special Issues	
Detriment of oral contraceptives	D
Detriment of DMPA injections	B
Detriment of alcohol	D
Detriment of smoking	C
Physical Activity and Exercise	
Effect on bone mass and density	A

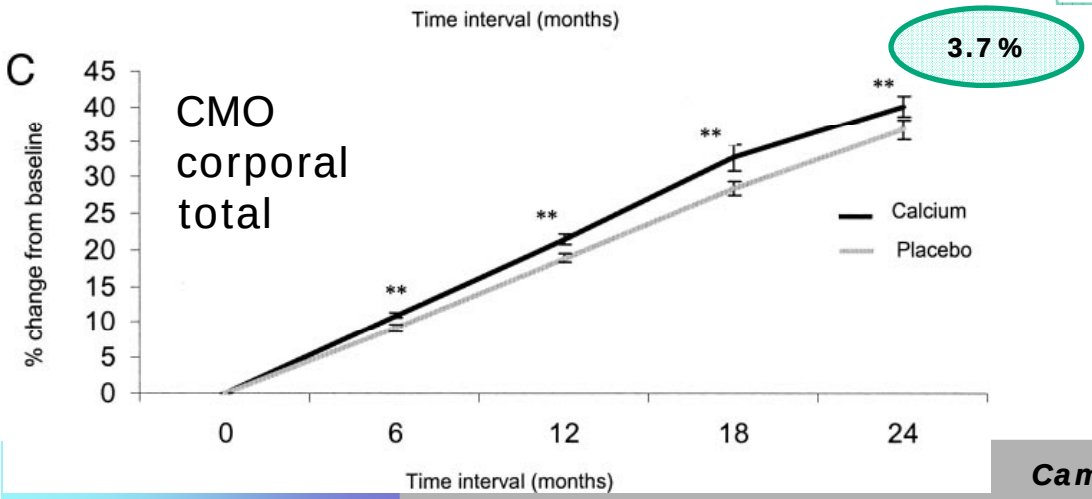
Sistema de grados de evidencia

- A • Fuerte
- B • Moderada
- C • Limitada
- D • Inadecuada

Calcio







n: 103 gemelas

8-13 años, premenárquicas

Duración: 24 meses (n:48)

Ingesta calcio basal: 786 mg/día vs 772 mg/día

Intervención: calcio carbonato1200 mg/día vs placebo

Cameron et al, JCEM , 2004, 89(10) 4916-4922

Calcio

Effect of calcium supplementation on height, weight, and bone measures and plasma osteocalcin concentrations[1]

	Absolute change (outcome − baseline)		Percentage difference in change (calcium − placebo)	
	Calcium group (n = 80)	Placebo group (n = 80)	Unadjusted (P)	Adjusted[2] (P)
			%	%
Height (cm)	5.1 ± 0.2	5.2 ± 0.2	−0.1 ± 0.2 (0.7)	−0.0 ± 0.0 (0.9)
Weight (kg)	2.2 ± 0.2	1.9 ± 0.2	0.8 ± 0.8 (0.3)	0.8 ± 0.8 (0.3)
Midshaft radius				
BMC (g/cm)	0.041 ± 0.005	0.033 ± 0.005	2.1 ± 1.6 (0.2)	3.0 ± 1.4 (0.03)
Size-adjusted BMC[3]				4.6 ± 0.9 (≤0.0001)
BW (cm)	0.012 ± 0.007	0.031 ± 0.006	−1.8 ± 0.9 (0.05)	−1.6 ± 0.9 (0.06)
BMD (g/cm^2)	0.037 ± 0.003	0.019 ± 0.003	3.9 ± 1.0 (0.0002)	4.5 ± 0.9 (≤0.0001)
Distal radius				
BMC (g/cm)	0.068 ± 0.011	0.035 ± 0.011	5.5 ± 3.4 (0.1)	8.4 ± 3.2 (0.009)
Size-adjusted BMC[3]				5.5 ± 2.7 (0.04)
BW (cm)	0.075 ± 0.017	0.049 ± 0.015	1.2 ± 1.2 (0.3)	2.0 ± 1.2 (0.09)
BMD (g/cm^2)	0.026 ± 0.005	0.014 ± 0.005	4.8 ± 3.0 (0.1)	7.0 ± 2.7 (0.01)

n: 160; 80 ♂/80♀; 8.3-11.9 años

12 meses, doble ciego, randomizado

Ingesta calcio basal: 342 mg/día

Intervención: calcio carbonato 1000mg/día vs placebo

Dibba et al, Am J Clin Nutr 2000; 71: 544-9

Calcio

Age	Calcium
	RDA (mg/d) (Intake That Meets Needs of ≥97.5% of Population)
Infants	
0–6 mo	200[b]
6–12 mo	260[b]
1–3 y	700
4–8 y	1000
9–13 y	1300
14–18 y	1300

Golden, et al. Pediatrics, Volume 134 (4), 2014

Actividad física

36 estudios randomizados, controlados y 20 observacionales

30/36 muestran beneficios estadísticamente significativos entre el grupo control y ejercicio

Actividad física

n:154; 72♂,82♀

15 años seguimiento

Inicio:8-15 años, hasta 23-30 años

	Inactive $n=18$	Average $n=36$	Active $n=18$
Chronological age (year)	14.1 (1.2)	14.3 (0.9)	14.6 (0.8)
Age at PHV	13.3 (1.2)	13.4 (0.9)	13.6 (0.8)
Maturity age (year from PHV)	0.9 (0.8)	0.9 (0.4)	1.0 (0.2)
Height (cm)	169.3 (8.5)	172.5 (5.8)	171.2 (6.5)
Weight (kg)	56.4 (8.9)	60.6 (9.0)	59.7 (9.2)
Total body lean mass (kg)	43.9 (6.0)	47.2 (5.3)	47.9 (6.2)
Total body fat mass (kg)	9.5 (5.7)	10.3 (6.4)	8.6 (4.4)
Calcium intake (mg/day)	1107 (481)	1347 (765)	1465 (681)
Physical activity (score)	2.1 (0.4)	3.0 (0.3)	3.7 (0.3)*

	Inactive $n=20$	Average $n=42$	Active $n=20$
Chronological age (year)	12.4 (1.3)	12.8 (0.8)	12.8 (0.8)
Age at PHV	11.6 (1.2)	11.9 (0.8)	11.8 (0.7)
Maturity age (year from PHV)	0.9 (0.3)	0.9 (0.4)	0.9 (0.3)
Height (cm)	156.6 (9.9)	160.2 (5.8)	161.3 (8.1)
Weight (kg)	46.0 (11.6)	51.4 (9.9)	49.9 (10.9)
Total body lean mass (kg)	31.0 (5.2)	34.3 (4.7)	35.1 (6.4)*
Total body fat mass (kg)	13.2 (6.8)	14.4 (6.9)	12.3 (5.3)
Calcium intake (mg/day)	926 (377)	1117 (443)	885 (334)
Physical activity (score)	2.0 (0.4)	2.8 (0.3)	3.6 (0.6)*

Baxter-Jones et al; Bone 43 (2008) 1101-1107

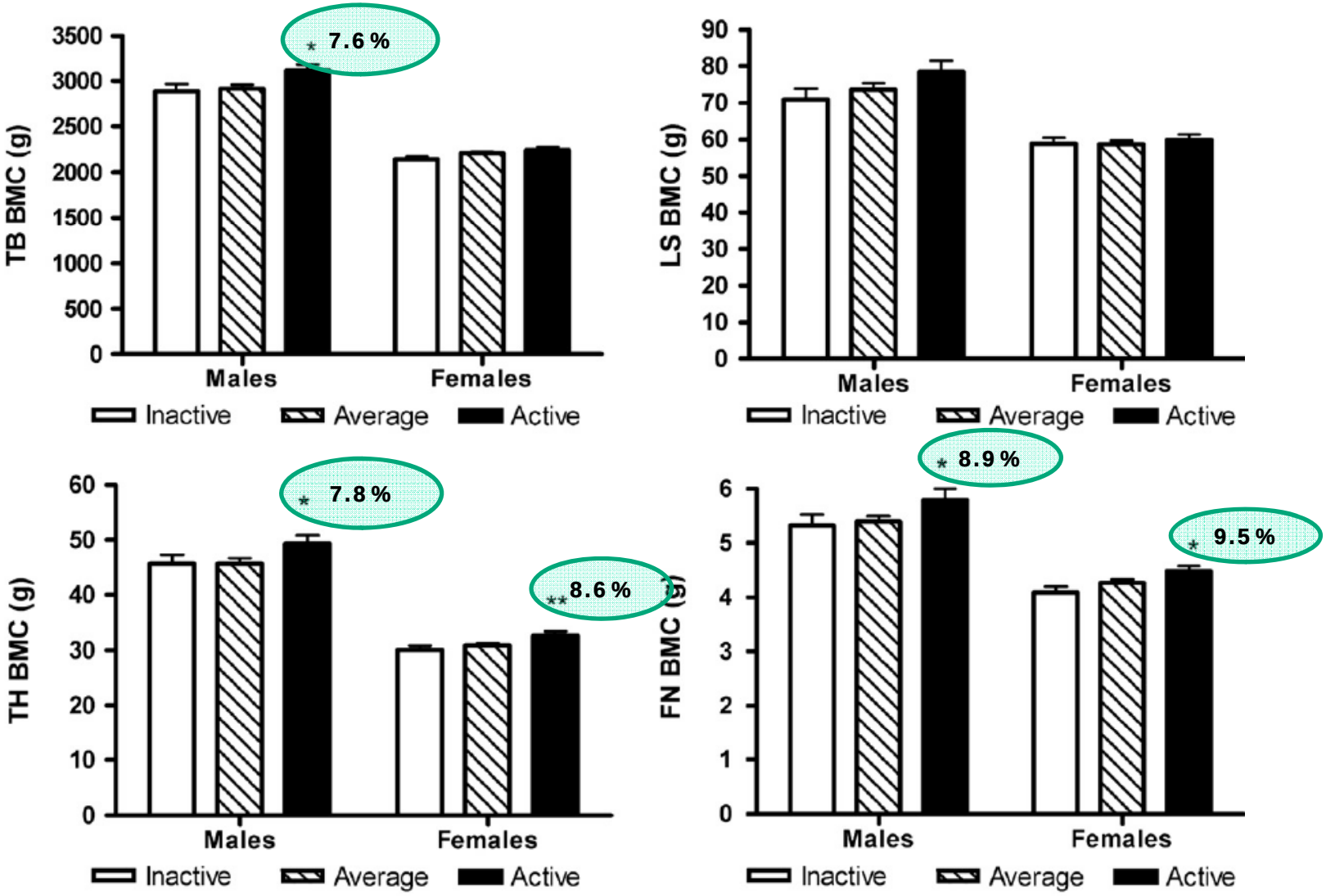
Actividad física

	Inactive (n=18)	Average (n=36)	Active (n=18)
Chronological age (year)	23.1 (2.2)	24.3 (2.0)	25.0 (2.5)*
Maturity age (year from PHV)	9.8 (2.6)	10.9 (1.9)	11.4 (2.4)
Height (cm)	177.8 (6.6)	180.5 (7.5)	178.5 (6.5)
Weight (kg)	79.6 (12.9)	84.7 (12.0)	83.6 (13.8)
Total body lean mass (kg)	57.8 (7.2)	61.1 (8.6)	61.9 (8.6)
Total body fat mass (kg)	17.6 (8.4)	19.2 (9.1)	17.1 (7.6)
Calcium intake (mg/day)	1390 (516)	1381 (673)	1412 (856)
Physical activity (score)	1.9 (0.5)	2.3 (0.6)	2.7 (0.5)*
Smokers (%)	22.2%	30.6%	11.1%
Alcohol consumption	3.5 (0.9)	3.3 (1.0)	3.5 (1.0)

	Inactive (n=20)	Average (n=42)	Active (n=20)
Chronological age (year)	22.7 (2.2)	23.5 (2.23)	22.6 (3.3)
Maturity age (year from PHV)	11.1 (2.4)	11.7 (2.2)	10.8 (2.1)
Height (cm)	164.2 (6.0)	167.1 (6.1)	168.3 (7.3)
Weight (kg)	65.3 (14.5)	69.7 (17.8)	68.9 (13.1)
Total body lean mass (kg)	38.1 (5.4)	40.5 (5.8)	41.5 (6.4)
Total body fat mass (kg)	23.8 (9.6)	25.4 (13.5)	23.7 (8.9)
Calcium intake (mg/day)	857 (408)	959 (447)	881 (345)
Physical activity (score)	1.8 (0.7)	2.1 (0.6)	2.5 (0.7)*
Smokers (%)	20.0%	40.5%	30.0%
Alcohol consumption[a]	3.9 (0.9)	3.9 (0.9)	3.6 (0.9)
Oral contraception (%)	70.0%	66.7%	60.0%
Oral contraception (years)	2.7 (1.5)	5.1 (3.3)	5.3 (2.9)*
Children 1 or more (%)	20.0%	26.2%	5.0%

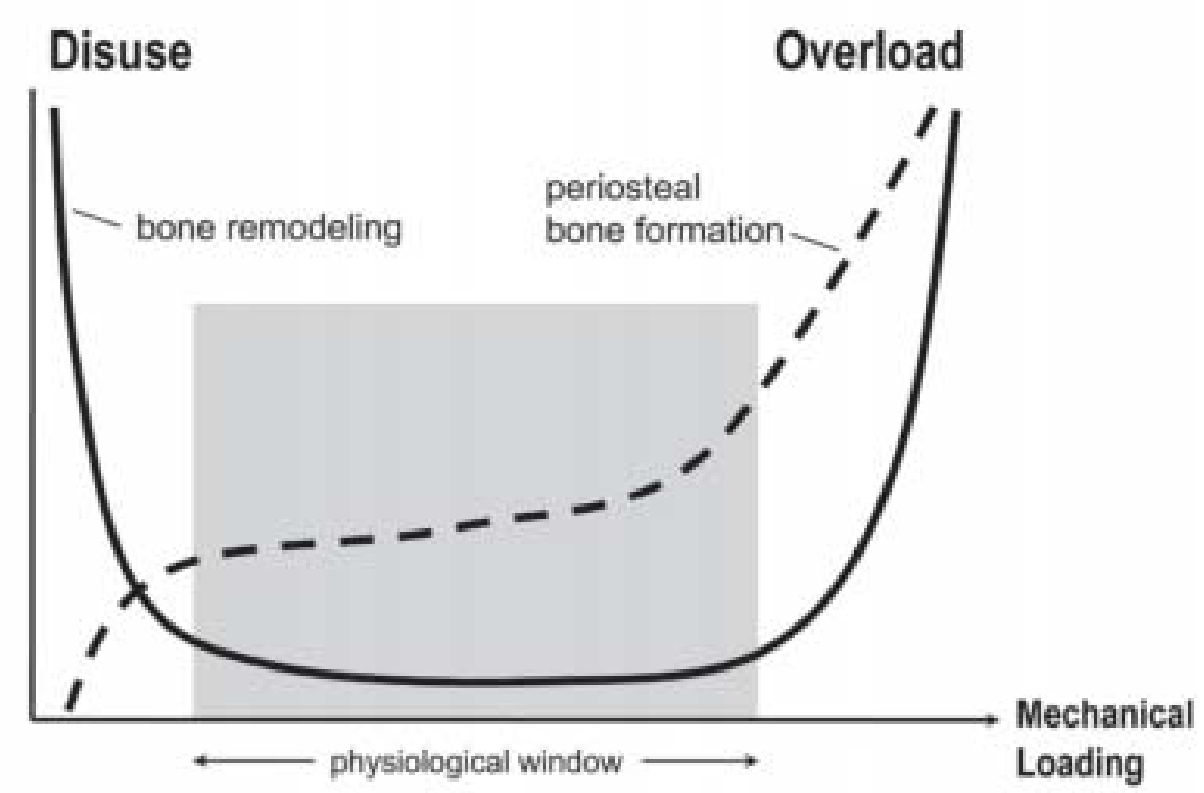
Baxter-Jones et al; Bone 43 (2008) 1101-1107

Actividad física



Baxter-Jones et al; Bone 43 (2008) 1101-1107

Fracturas por stress



Robling and Turner. Mechanical Signaling for Bone Modeling and Remodeling. Crit Rev Eukaryot Gene Expr. 2009

Vitamina D

-Restricción a exposición solar
-Pigmentación de la piel
-Latitud (>33°)
-Polución ambiental
-Protector solar (>Factor8)

Otros factores:
-Obesidad
-Drogas (GC, AC, antirretrovirales)

Vitamina D

Age	Vitamin D
	RDA (IU/d) (Intake That Meets Needs of ≥97.5% of Population)
Infants	
0–6 mo	400[b]
6–12 mo	400[b]
1–3 y	600
4–8 y	600
9–13 y	600
14–18 y	600

Golden, et al. Pediatrics, Volume 134 (4), 2014

Lácteos

Food	Calcium Content (mg)
Dairy foods	
Milk	
Whole milk	276
Reduced fat milk (2%)	293
Low-fat milk (1%)	305
Skim milk (nonfat)	299
Reduced-fat chocolate milk (2%)	275
Low-fat chocolate milk (1%)	290
Yogurt	
Plain yogurt, low-fat	415
Fruit yogurt, low-fat	345
Plain yogurt, nonfat	452
Cheese	
Romano cheese	452
Swiss cheese	336
Pasteurized processed American cheese	323
Mozzarella cheese, part skim	311
Cheddar cheese	307
Muenster cheese	305
Nondairy foods	
Salmon	32
Sardines, canned	325
White beans, cooked	191
Broccoli, cooked	72
Broccoli, raw	42
Collards, cooked	226
Spinach, cooked	249
Spinach, raw	30
Baked beans, canned	120
Tomatoes, canned	84

Golden, et al. Pediatrics, Volume 134 (4), 2014

2) Prevención secundaria

- Genetic conditions
  - Osteogenesis imperfecta
  - Idiopathic juvenile osteoporosis
  - Turner syndrome
- Chronic illness
  - Cystic fibrosis
  - Connective tissue disorders (lupus, juvenile idiopathic arthritis, juvenile dermatomyositis)
  - Inflammatory bowel disease, celiac disease
  - Chronic renal failure
  - Childhood cancer
  - Cerebral palsy
  - Chronic immobilization
- Eating disorders, including anorexia nervosa, bulimia nervosa, eating disorders not otherwise specified, and the female athlete triad
- Endocrine conditions
  - Cushing syndrome
  - Hypogonadism
  - Hyperthyroidism
  - Hyperparathyroidism
  - Growth hormone deficiency
  - Diabetes mellitus
- Medications
  - Glucocorticoids
  - Anticonvulsants
  - Chemotherapy
  - Leuprolide acetate
  - Proton pump inhibitors
  - Selective serotonin reuptake inhibitors
  - DMPA

3) Prevención terciaria

Tratamiento adecuado de la enfermedad de base

Suplementar con: -**calcio** a pacientes con GC o bajo dietas que impiden cumplir requerimientos diarios

-**vitamina D** a los no mantienen niveles normales

Journal of Pediatric Rehabilitation Medicine: An Interdisciplinary Approach 7 (2014) 133–142 .
Bone health in children with neuromuscular disorders. K.Nessa and S. Apkonb

Conclusiones

La adolescencia es un período crítico para optimizar la adquisición del PMO

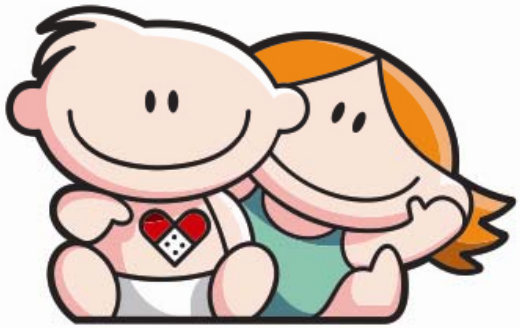
Los beneficios de la adecuada ingesta de calcio y la actividad física cuentan con la mejor evidencia científica disponible en la actualidad

Los beneficios de la ingesta de lácteos y de vitamina D, también cuentan con adecuada evidencia científica

Conclusiones

Los efectos de otros macro y micronutrientes sobre la salud ósea cuentan con un grado de evidencia científica limitado

Es importante analizar qué otros factores y estilos de vida se asocian al desarrollo de un mayor PMO y fortaleza ósea



Hospital de Pediatría
Garrahan