NUTRICIÓN DEPORTIVA

MICRONUTRIENTES II

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Micronutrientes de especial Interés

- ~~Hierro (Fe)~~
- Calcio
- Vitamina D
- Antioxidantes
- Vitamina B12 – sólo en algunos grupos poblacionales

Calcio (Ca)

Funciones del Calcio en el Ejercicio

- Iniciación de contracción muscular
- Transmisión de impulsos nerviosos
- Control de pasaje de líquidos a través de las membranas celulares
- Activación de numerosas enzimas: ATPasas, lipasas, etc.

Recomendaciones de Ca

1000 mg/día

- ✓ ¿Discrepancia en las recomendaciones?

Table 19: Selected Examples of Calcium Recommendations

mCa/d	*USA/Canada*[A]	*EU*[B]	*FAO/WHO*[C]
Adults <50y	1000	700	400-500
Adults >50y	1200	700	400-500
Children 1-3 y	500	400	400-500
Boys 11-18 y	1300	1000	500-700
Girls 11-18 y	1300	800	500-700
Pregnancy women	1000	700	1000-1200
Breastfeeding women	100	1200	1000-1200

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Global dietary calcium intake among adults: a systematic review

Review | Open access | Published: 12 October 2017

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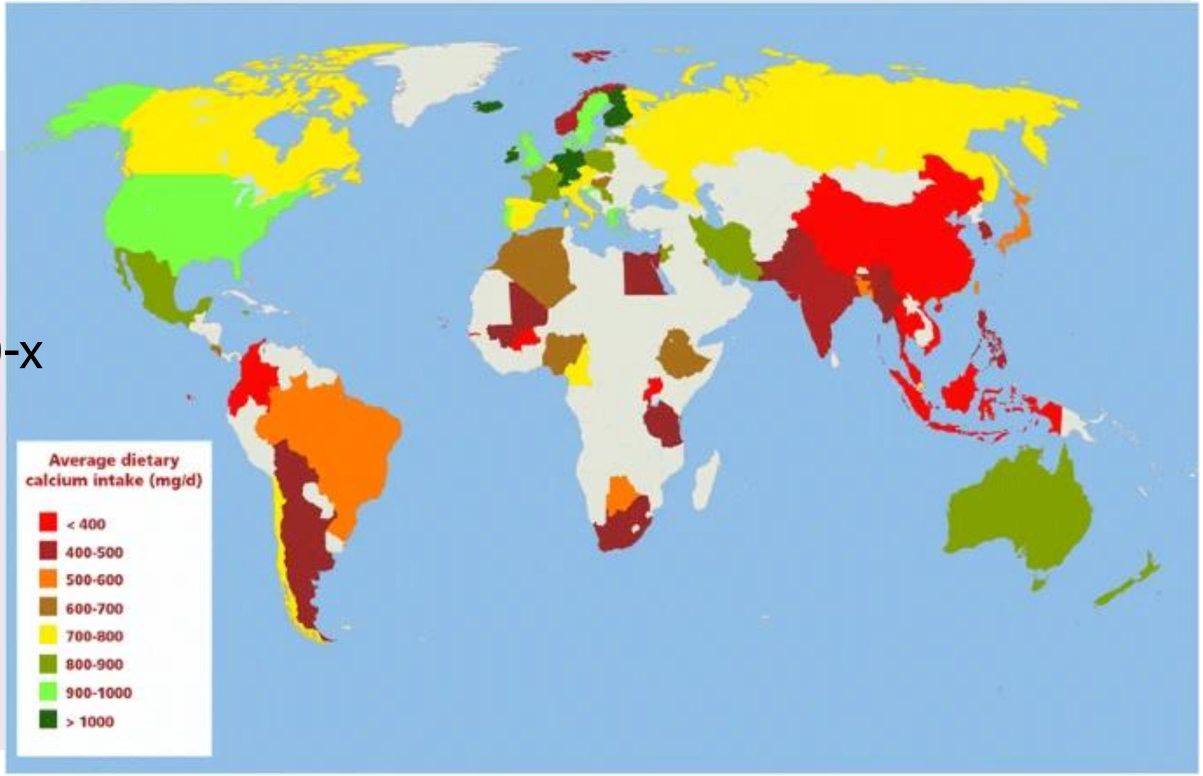
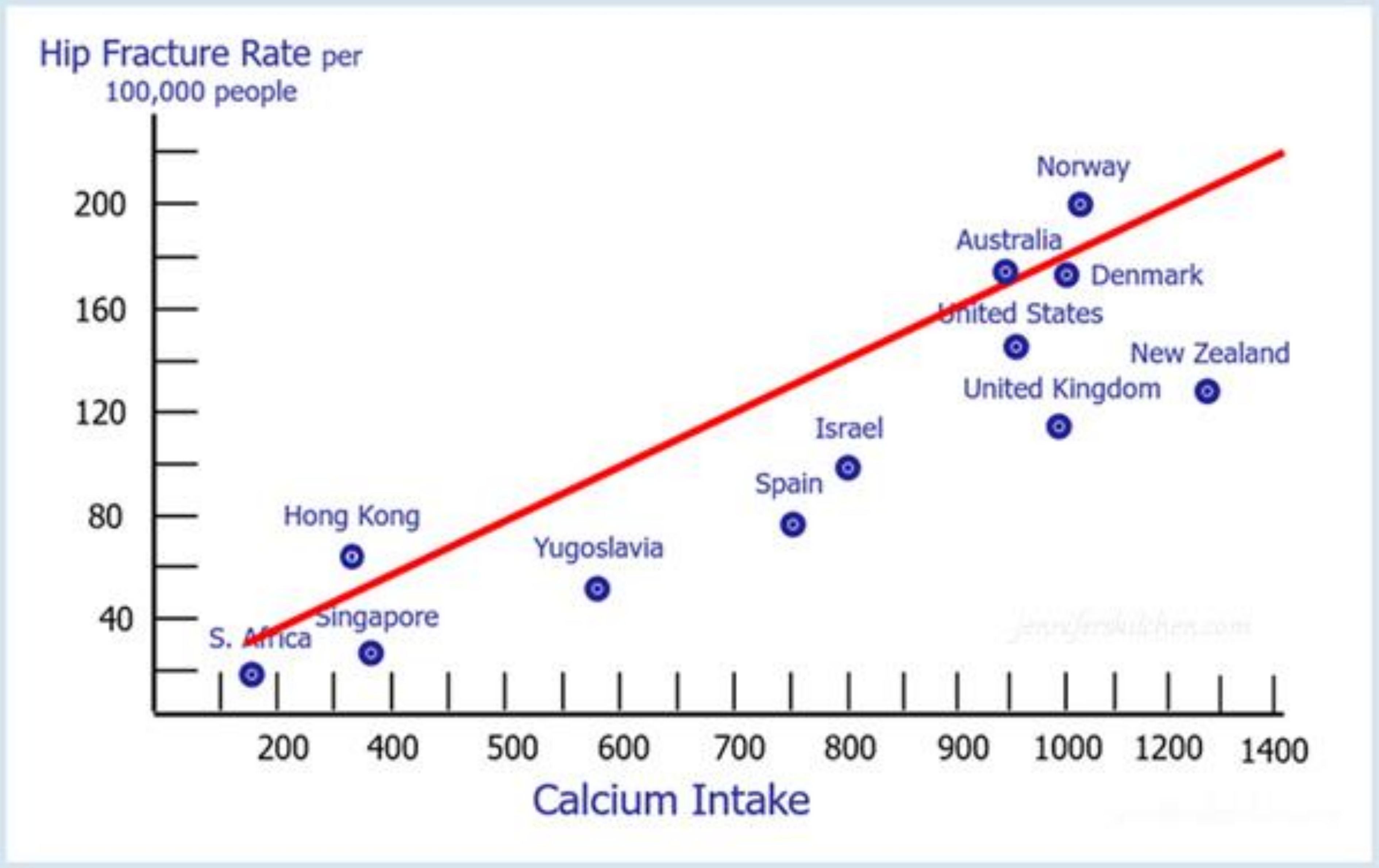
E. M. Balk, G. P. Adam, V. N. Langberg, A. Earley, P. Clark, P. R. Ebeling, A. Mithal, R. Rizzoli, C. A. F. Zerbini, D. D. Pierroz & B. Dawson-Hughes for the International Osteoporosis Foundation Calcium Steering Committee

https://link.springer.com/article/10.1007/s00198-017-4230-x




Hip Fracture Rate per
100,000 people
200
160
120
80
40
Norway
Australia
Denmark
United States
New Zealand
United Kingdom
Israel
Spain
Hong Kong
Yugoslavia
Singapore
S. Africa
200
400
500
600
700
800
900
1000
1200
1400
Calcium Intake

OPEN ACCESS

Calcium intake and risk of fracture: systematic review

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ABSTRACT

OBJECTIVE

To examine the evidence underpinning recommendations to increase calcium intake through dietary sources or calcium supplements to prevent fractures.

DESIGN

Systematic review of randomised controlled trials and observational studies of calcium intake with fracture as an endpoint. Results from trials were pooled with random effects meta-analyses.

DATA SOURCES

Ovid Medline, Embase, PubMed, and references from relevant systematic reviews. Initial searches undertaken in July 2013 and updated in September 2014.

ELIGIBILITY CRITERIA FOR SELECTING STUDIES

Randomised controlled trials or cohort studies of dietary calcium, milk or dairy intake, or calcium supplements (with or without vitamin D) with fracture as an outcome and participants aged >50.

RESULTS

There were only two eligible randomised controlled trials of dietary sources of calcium (n=262), but 50 reports from 44 cohort studies of relations between dietary calcium (n=37), milk (n=14), or dairy intake (n=8) and fracture outcomes. For dietary calcium, most studies reported no association between calcium

Funnel plot inspection and Egger's regression suggested bias toward calcium supplements in the published data. In randomised controlled trials at lowest risk of bias (four studies, n=44505), there was no effect on risk of fracture at any site. Results were similar for trials of calcium monotherapy and co-administered calcium and vitamin D. Only one trial in frail elderly women in residential care with low dietary calcium intake and vitamin D concentrations showed significant reductions in risk of fracture.

CONCLUSIONS

Dietary calcium intake is not associated with riskof fracture, and there is no clinical trial evidence that increasing calcium intake from dietary sources prevents fractures. Evidence that calcium supplements prevent fractures is weak and inconsistent.

Introduction

Older men and women are recommended to take at least 1000-1200 mg/day of calcium for bone health and prevention of fractures.[1] The average intake in the diet in Western countries is 700-900 mg/day, and lower in Asia and Africa, meaning that most older people would need to take calcium supplements to meet these recommendations. These guidelines for calcium intake have been widely implemented, and, in some Western countries, more than 30-50% of older women take calcium supplements.[2-5] Clinical trials of calcium supplements at doses of 1000 mg/day, however, have reported

Resultados

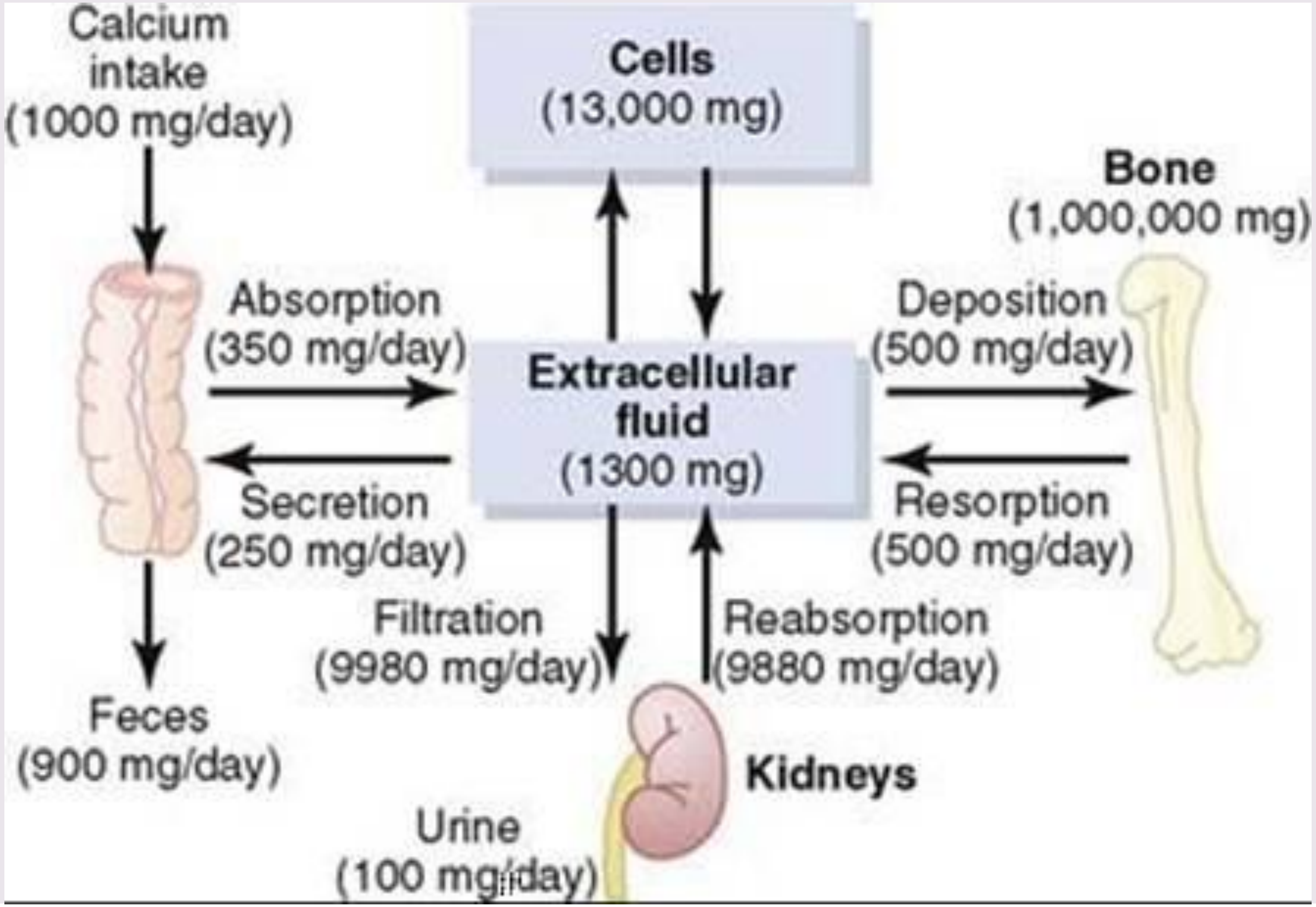
- ✓ La ingesta de calcio en la dieta no está asociada con el riesgo de fractura
- ✓ No hay evidencia en ensayos clínicos que aumentando ingesta de calcio de fuentes dietéticas se previenen fracturas
- ✓ Evidencia débil e inconsistente de que los suplementos de calcio previenen fracturas

Dr. Walter Willett

"No está claro qué cantidad de Ca deben consumir las personas"

- ✓ Cambios de paradigma a partir de 2005
- ✓ Dos estudios británicos demostraron que la ingesta de calcio no previene fracturas, incluso en combinación con toma de Vit D
- ✓ 2006: Women's Health Initiative - suplementación de Ca + Vit D mujeres postmenopáusicas – igual índice de fracturas que las que tomaron placebo
- ✓ 2007 meta análisis de 12 estudios: no se encontró conexión entre el alto consumo de Ca (ni alimentario, ni suplementos) con un menor riesgo de fractura de cadera

Intercambio de Ca entre los tejidos








	Food	Amount	Calcium Content
DAIRY	Yoghurt	200g	300mg
	Cheese	2 slices (40g)	300mg
	Cottage cheese	½ cup	100mg
SEAFOOD	Sardines	85g	400mg
	Oysters	100g	100mg
	Pink Salmon – canned in water	95g can	290mg
PLANT SOURCES	Tofu – firm	100g	300mg
	Tahini	1tbs	65mg
	Dried Figs	6	160mg
	Broccoli – raw	1 cup	30mg
	Soy beans – canned	200g	100mg
	Kale - cooked	1 cup	40mg
	Almonds	10	30mg







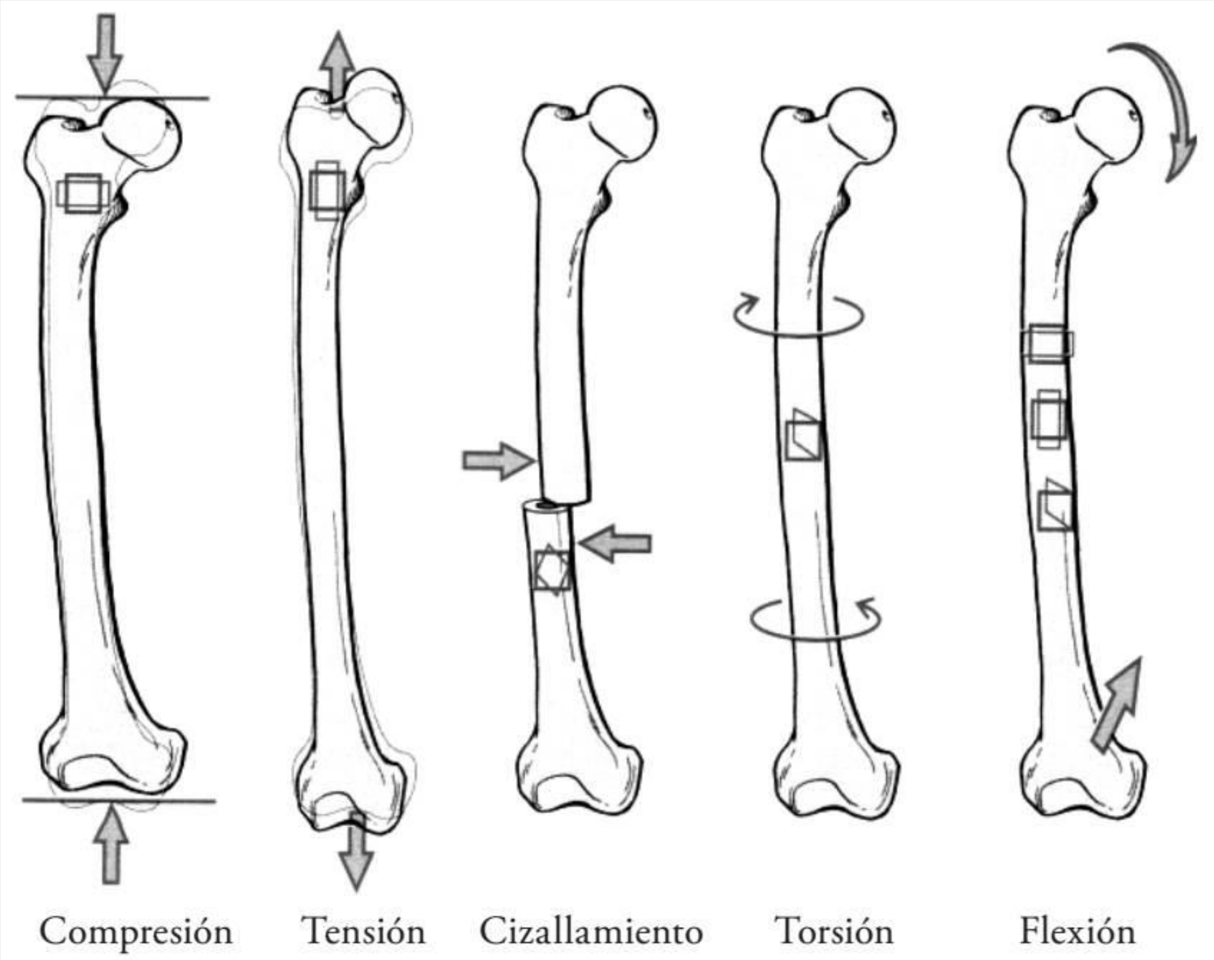
Múltiples funciones

- ✓ Permeabilidad de membranas celulares
- ✓ Excitabilidad y conducción nerviosa
- ✓ Contracción muscular
- ✓ Enzimas celulares
- ✓ Equilibrio hidrosalino y pH
- ✓ Secreción glandular
- ✓ Liberación hormonal y vesículas sinápticas, respuesta a hormonas
- ✓ Coagulación de sangre
- ✓ Formación de hueso y dientes

Ingestas de Ca en atletas

- ✓ EEUU: 1031 mg/día
  - ✓ Gimnastas NCAA 600 mg/día
- ✓ Europa: 896 mg/día
- ✓ África: 368 mg/día
- ✓ Fondistas Kenia 600 mg/día
- ✓ Asia: 305 mg/día

Cargas mecánicas sobre el esqueleto



Comparative Study > Med Sci Sports Exerc. 2000 Jan;32(1):63-9.
doi: 10.1097/00005768-200001000-00011.

Premenarcheal gymnasts possess higher bone mineral density than controls

S M Nickols-Richardson[1], C M Modlesky, P J O'Connor, R D Lewis

Affiliations + expand

PMID: 10647531 DOI: 10.1097/00005768-200001000-00011

Abstract

Purpose: The purpose of this study was to examine bone mineral density (BMD), body composition, dietary intake, physical activity, and energy expenditure (EE) in premenarcheal gymnasts (N = 16; age = 10.5 +/- 1.5 yr) in comparison to age- (+/- 0.35 yr), height- (+/- 2.6 cm), and weight- (+/- 1.5 kg) matched controls (N = 16; age = 10.5 +/- 1.3 yr). It was hypothesized that premenarcheal gymnasts would have higher BMD, fat-free soft tissue (FFST) mass, physical activity, and EE, but lower fat mass, percent body fat, and dietary intake than controls.

Methods: Dual energy x-ray absorptiometry was used to measure whole body, femur, and lumbar spine (L1-4) BMD, FFST, and fat mass. Three-day diet records were used to estimate mean daily dietary energy, macronutrient, and calcium intakes. Physical activity and EE were estimated by the Seven-Day Physical Activity Recall.

Resultados

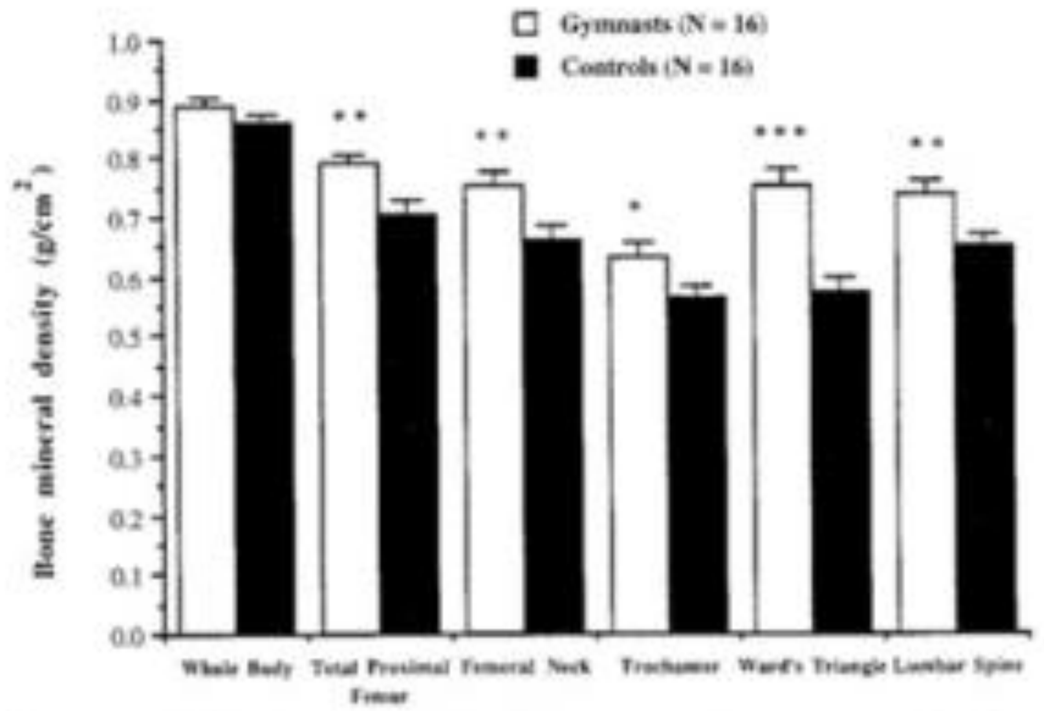


Figure 1—BMD of premenarcheal gymnasts and controls at six sites. Values are means ± SEM. Asterisks indicate a significant difference between gymnasts and controls (*t*-test for paired samples): $^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.0001$.

Gimnastas mayor DMO en fémur y lumbares que población control

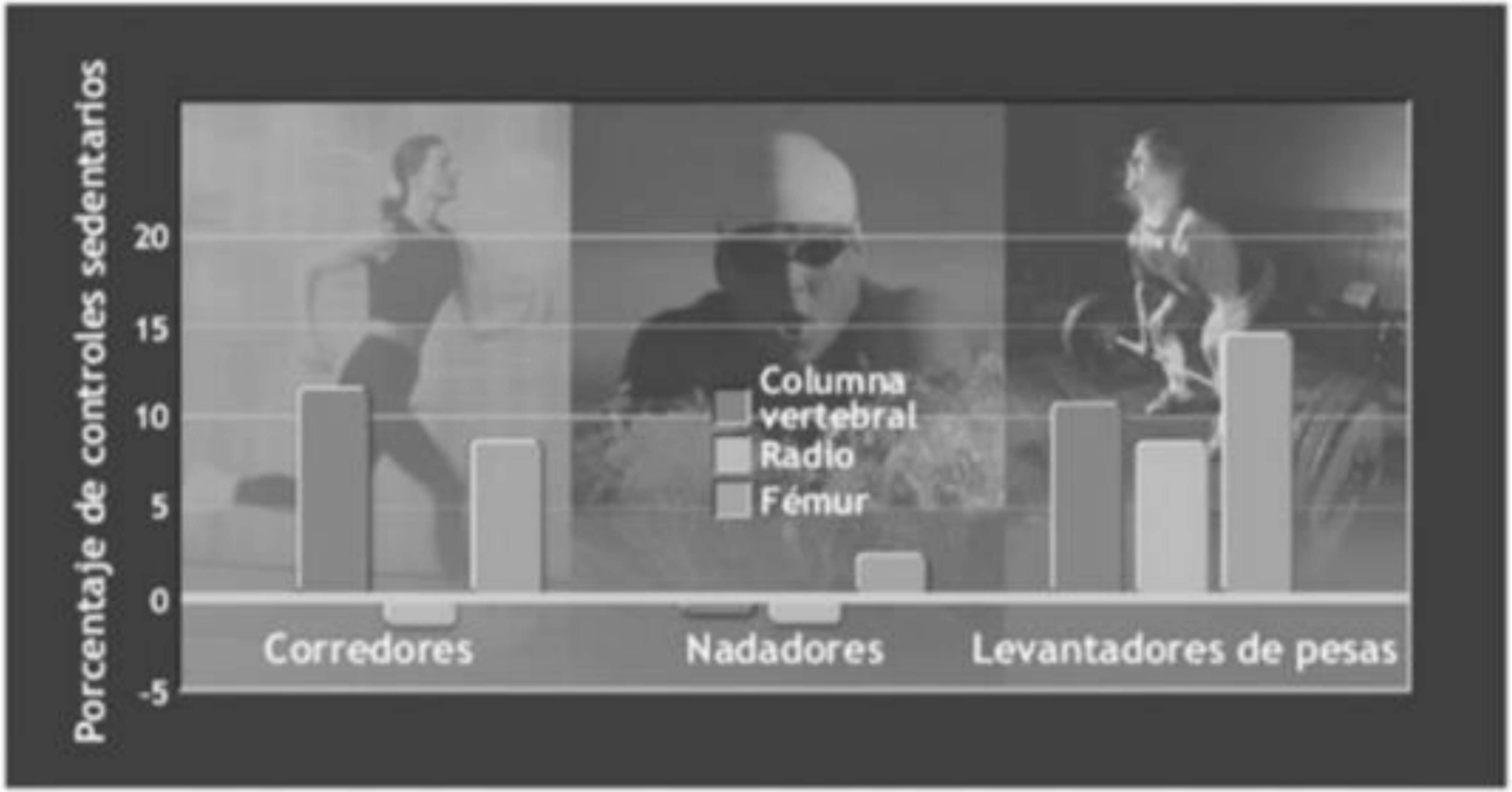


FIGURA 2.9 • Densidad mineral ósea expresada como porcentaje de valores de controles sedentarios en 3 sitios esqueléticos para corredores, nadadores y levantadores de pesas. (Adaptada con autorización de Drinkwater BL. Physical activity, fitness, and osteoporosis. In: Bouchard C, et al., eds. *Physical Activity, Fitness, and Health.* Champaign, IL: Human Kinetics, 1994).

Comparative Study > Med Sci Sports Exerc. 1993 Oct;25(10):1103-9.

Bone mineral density in elite junior Olympic weightlifters

B P Conroy[1], W J Kraemer, C M Maresh, S J Fleck, M H Stone, A C Fry, P D Miller, G P Dal

Affiliations + expand

PMID: 8231753

Abstract

The purpose of this study was to examine the relationship of bone mineral density (BMD)
strength in highly trained young male athletes in order to gain insights concerning the inf
heavy resistance training on BMD. Twenty-five elite junior weightlifters (age, 17.4 +/- 1.4 y
age-matched controls (16.9 +/- 1.1 yr) volunteered for this investigation. Measurements c
(g.cm-2) utilizing dual energy x-ray absorptiometry were obtained for the lumbar spine (L2-4) and the
proximal femur (neck; trochanter, Ward's triangle). The BMD values for the junior lifters were
be significantly greater at all sites for the junior weightlifters compared with their age-matc
control group. The BMD values of the spine and femoral neck of the junior weightlifters wh
compared with adult reference data (i.e., 20-39 yr old men) were found to be significantly g
Both simple and multiple regression analyses demonstrated significant relationships of BM
strength accounting for 30-65% of the variance. These data suggest that in elite junior weig
muscle strength, highly specific to the sport of weightlifting, has a major influence on BMD
influence of the chronic overloads experienced in training.

TABLE 1. Bone mineral density values for the spine and proximal femur.

Anatomical Site	Bone Mineral Density ($g \cdot cm^{-2}$) Junior Lifters	Controls	[% Comparison to Adult Reference Data] (% Comparison to Matched Controls)
Spine	1.41 ± 0.20*#	1.06 ± 0.21	[113%] (133%)
Femoral neck	1.30 ± 0.15*#	1.05 ± 0.12	[131%] (124%)
Trochanter	1.05 ± 0.13*	0.89 ± 0.12	ND (118%)
Ward's triangle	1.26 ± 0.20*	0.99 ± 0.16	ND (127%)

Values are means ± 1 SD. * $P \leq 0.05$ from corresponding control data. # $P \leq 0.05$ from corresponding adult reference data. ND = no reference data available.

Levantadores olímpicos de 17años
- ✓ DMO superior vs controles de la misma edad

- ✓ La carga mecánica por ejercicios de fuerza e impacto retrasa el envejecimiento óseo
- ✓ Grupos físicamente activos poseen mejor DMO vs grupos sedentarios
- ✓ Si bien los mayores beneficios se obtienen a edades tempranas de la vida, hacer ejercicios con carga mecánica tendrá beneficios para la salud ósea a lo largo de toda la vida, no importa cuando se comience

In the NEWS

Calcium Supplements May Increase Heart Disease Risk

Results could be tied to inadequate vitamin D.

Calcium supplements, commonly taken by older adults to ward off osteoporosis, may increase the risk of heart attack. An international team of researchers examined data from 11 studies covering around 12,000 people who took calcium supplements without vitamin D. In all of the studies, people older than 40 years took supplements with calcium doses of 500 mg or higher daily. Compared with those who took a placebo, people who took calcium had a 31% higher risk of heart attack. There were also slightly higher, nonsignificant increases in the risk of stroke and death.

widespread use of calcium supplements means that even a small increase in incidence of cardiovascular disease could translate into a large burden of disease in the population," write the authors. Although many people take calcium supplements to prevent osteoporosis, these supplements only marginally reduce the risk of bone fractures—by about 10%. "Maintaining a healthy weight, being physically active, not smoking, and having bone density measured are other important aspects of osteoporosis management," author Ian R. Reid told *AJN.*

Dee Sandquist, a spokesperson for the American Dietetic

vitamin D to their regimens because other studies show no risk of heart problems when calcium and vitamin D are combined.
—*Carol Potera*

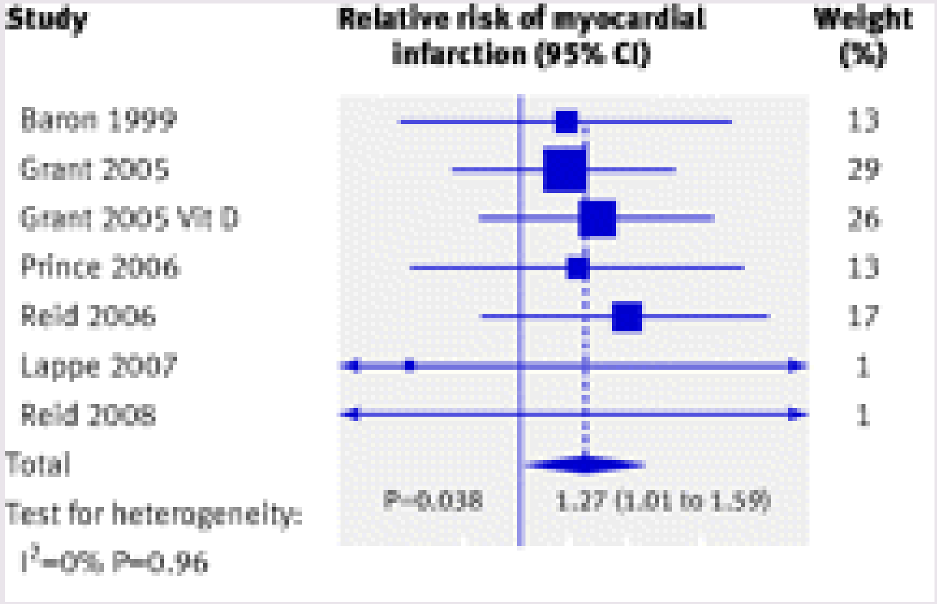
November 2010AJN American Journal of Nursing 110(11):18

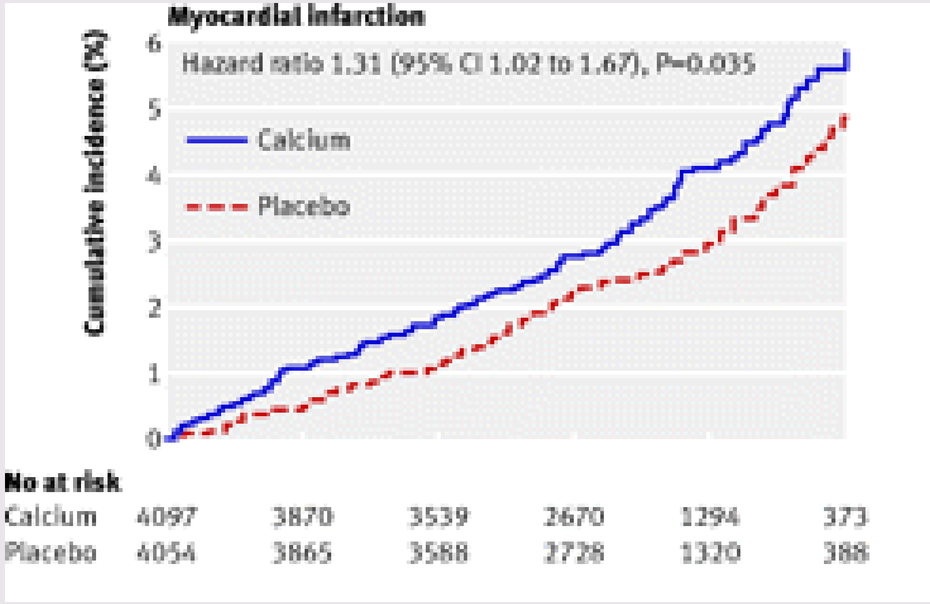
Research

Effect of calcium supplements on risk of myocardial infarction and cardiovascular events: meta-analysis

BMJ 2010 ; 341 doi: https://doi.org/10.1136/bmj.c3691 (Published 29 July 2010)
Cite this as: *BMJ* 2010;341:c3691

Mark J Bolland, senior research fellow [1], Alison Avenell, clinical senior lecturer [2], John A Baron, professor [3], Andrew Grey, associate professor [1], Graeme S MacLennan, senior research fellow [2], Greg D Gamble, research fellow [1], Ian R Reid, professor [1]





Analicemos…

- ✓Meta-análisis con 100 participantes
- ✓Suplementos de Ca aumentó 31% riesgo de IAM
- ✓Si se da a 1000 personas suplementos de Ca se pueden prevenir 26 fracturas, generando 14 IAM, 13 ACV y 13 muertes

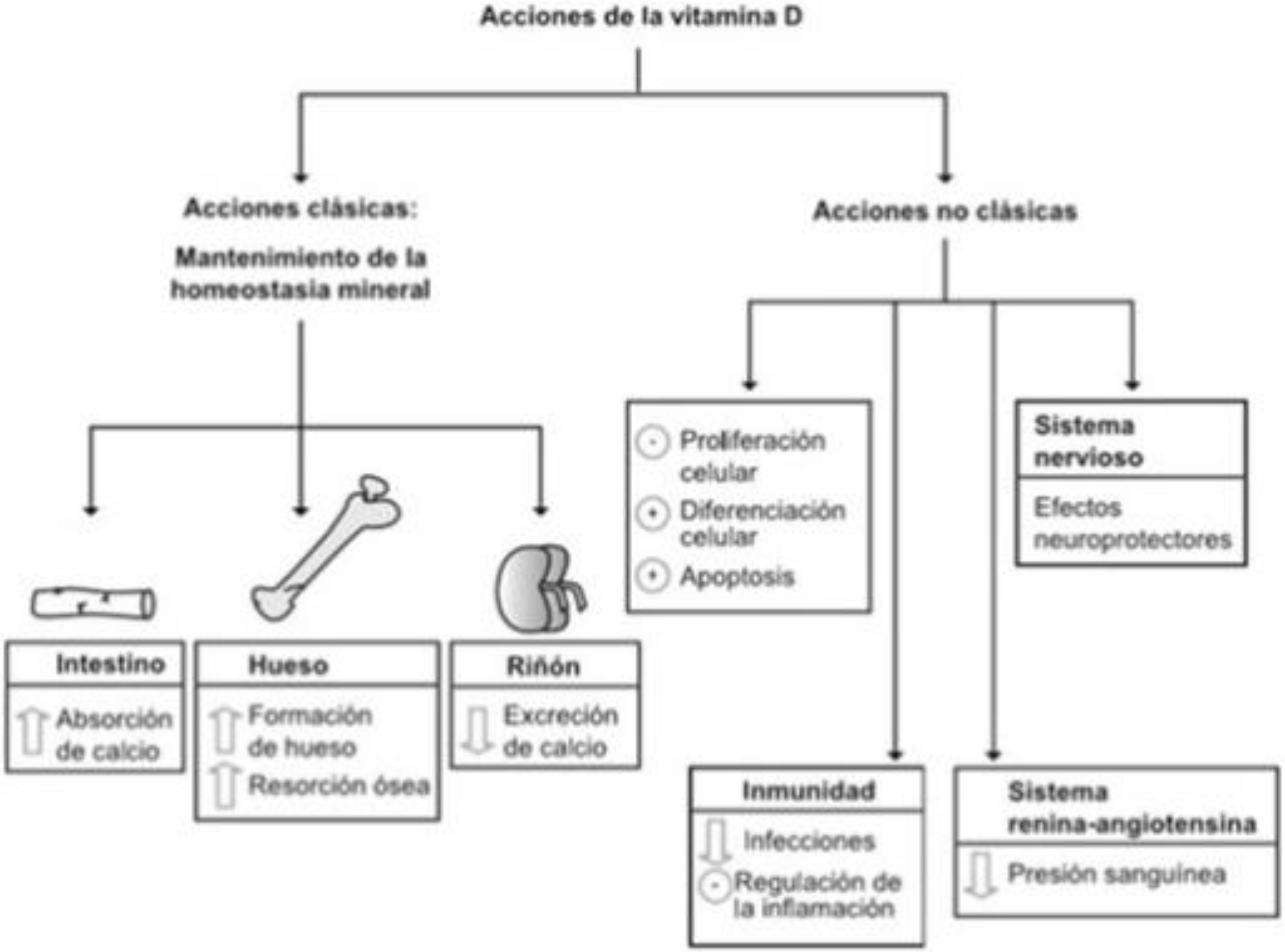
Micronutrientes de especial Interés

- ~~Hierro (Fe)~~
- ~~Calcio~~
- Vitamina D
- Antioxidantes
- Vitamina B12 – sólo en algunos grupos poblacionales

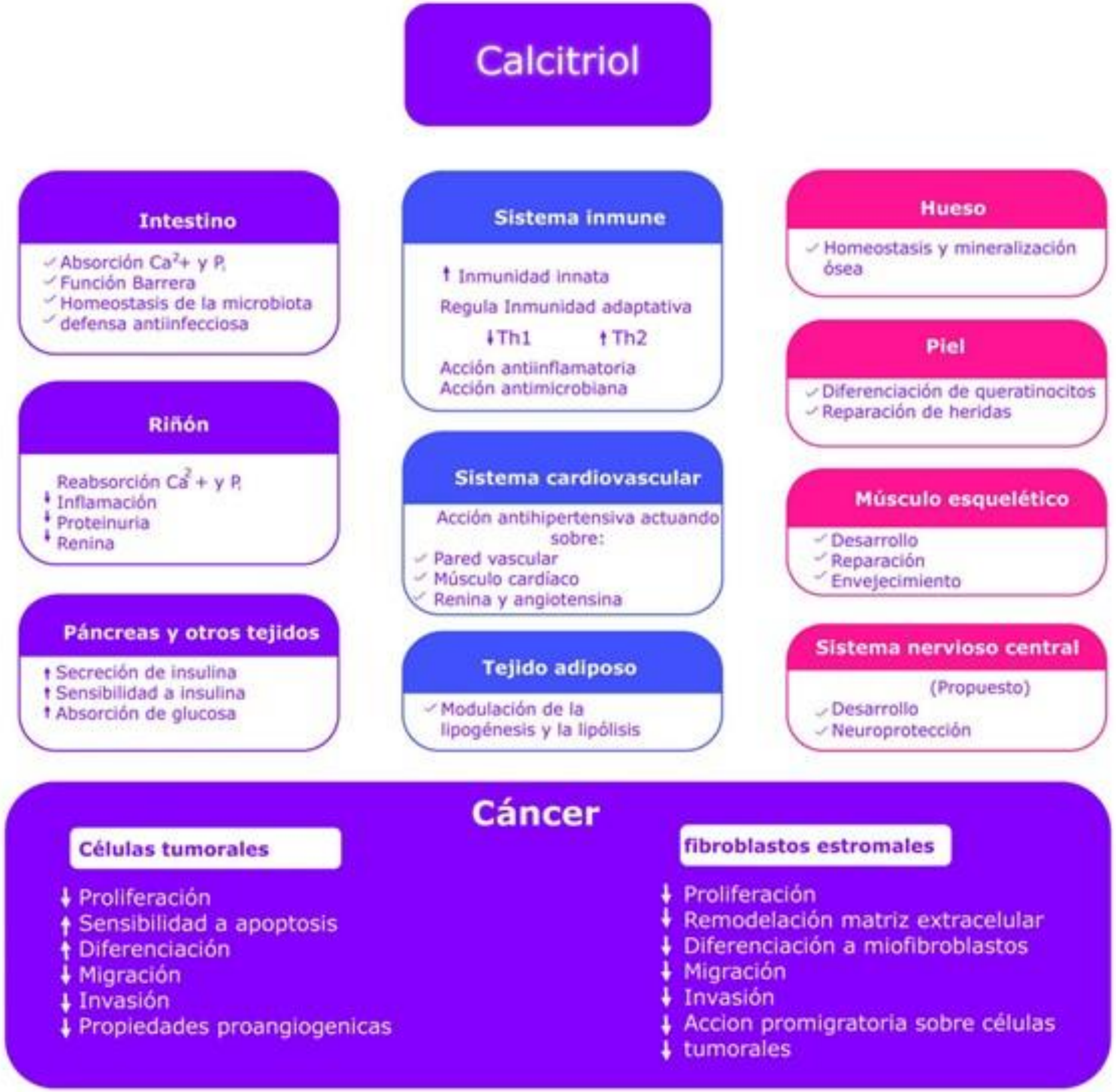
Vitamina D

Funciones de Vitamina D en ejercicio

- ✓Regula absorción y metabolismo de Ca y P
- ✓Papel importante en salud ósea
- ✓Mediador en funciones metabólicas y genéticas
- ✓Prevención de lesiones
- ✓Mejora en el funcionamiento neuromuscular
- ✓Reducción de inflamación
- ✓Reducción de riesgo de fractura por sobrecarga
- ✓Regula insulina

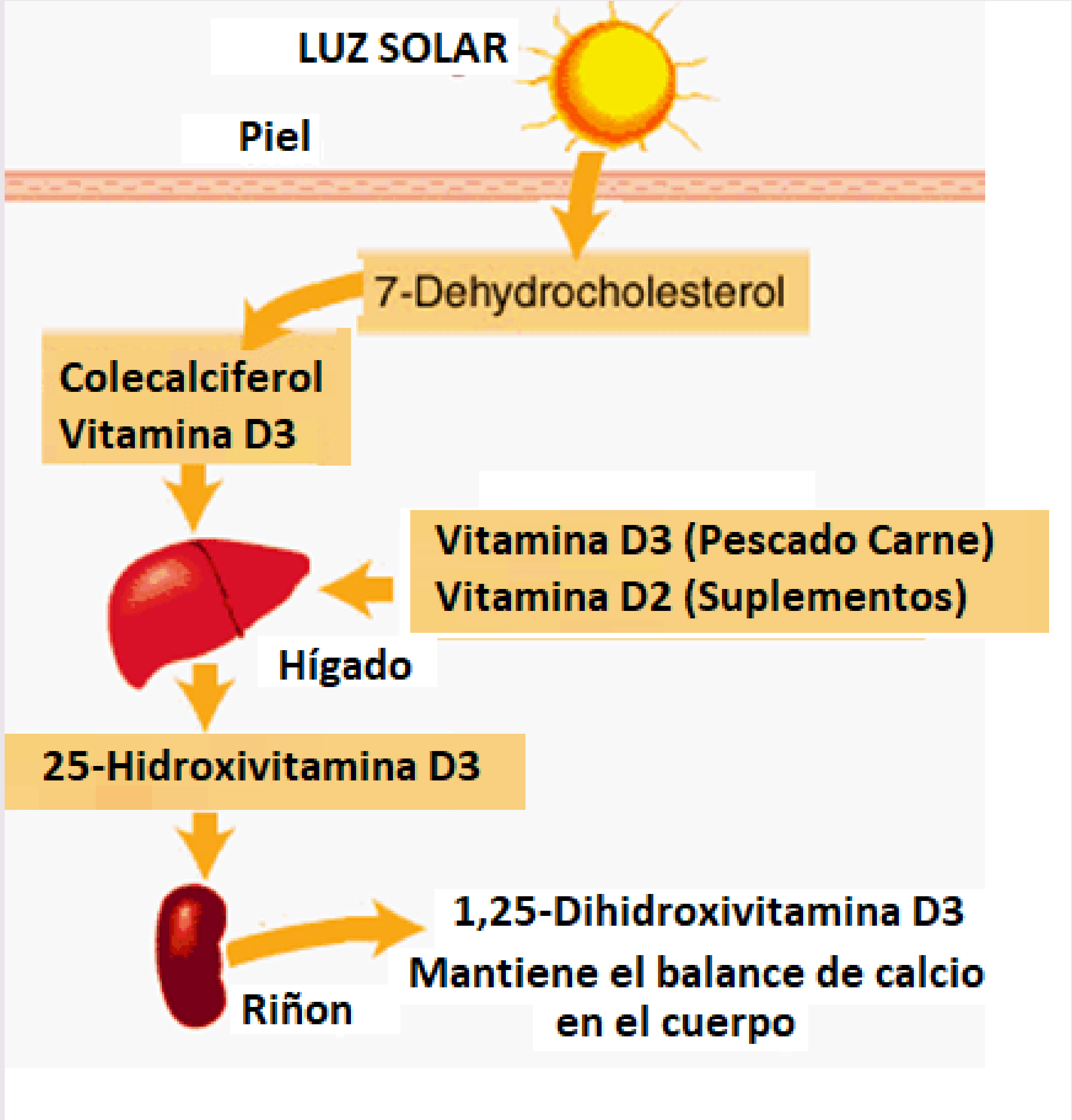


Trat. Nutrición. Gil. Tomo 1



Calcitriol
Intestino
Absorción Ca2+ y Pi
Función Barrera
Homeostasis de la microbiota
defensa antiinfecciosa
Riñón
Reabsorción Ca2+ y Pi
↓ Inflamación
↓ Proteinuria
↓ Renina
Páncreas y otros tejidos
↑ Secreción de insulina
↑ Sensibilidad a insulina
↑ Absorción de glucosa
Sistema inmune
↑ Inmunidad innata
Regula Inmunidad adaptativa
↓Th1 ↑Th2
Acción antiinflamatoria
Acción antimicrobiana
Sistema cardiovascular
Acción antihipertensiva actuando sobre:
Pared vascular
Músculo cardiaco
Renina y angiotensina
Tejido adiposo
Modulación de la lipogénesis y la lipólisis
Hueso
Homeostasis y mineralización ósea
Piel
Diferenciación de queratinocitos
Reparación de heridas
Músculo esquelético
Desarrollo
Reparación
Envejecimiento
Sistema nervioso central
(Propuesto)
Desarrollo
Neuroprotección
Cáncer
Células tumorales
↓ Proliferación
↑ Sensibilidad a apoptosis
↑ Diferenciación
↓ Migración
↓ Invasión
↓ Propiedades proangiogenicas
fibroblastos estromales
↓ Proliferación
↓ Remodelación matriz extracelular
↓ Diferenciación a miofibroblastos
↓ Migración
↓ Invasión
↓ Accion promigratoria sobre células
↓ tumorales

Metabolismo de la Vitamina D



Requerimiento Vitamina D

- ✓  600 UI/día (15 mcg)

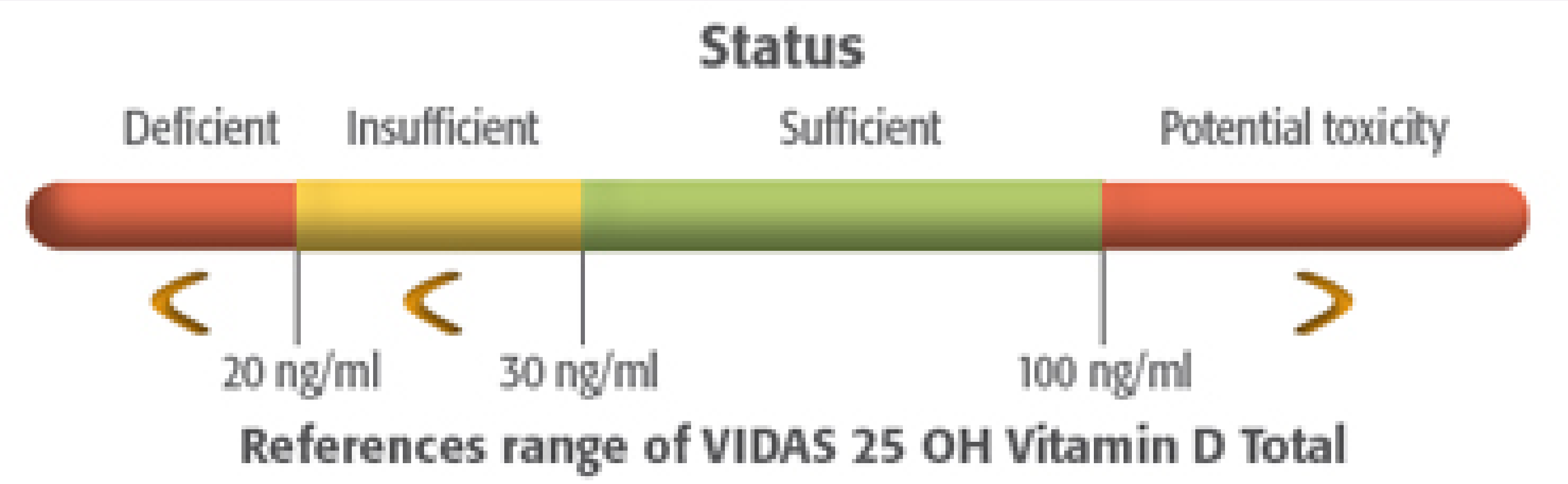
- ✓ **UL 4000 UI (100 mcg)**
- ✓ El examen de 25-hidroxi-vitamina D [25(OH)D] es la forma más exacta de medir cuánta vitamina D hay en el cuerpo

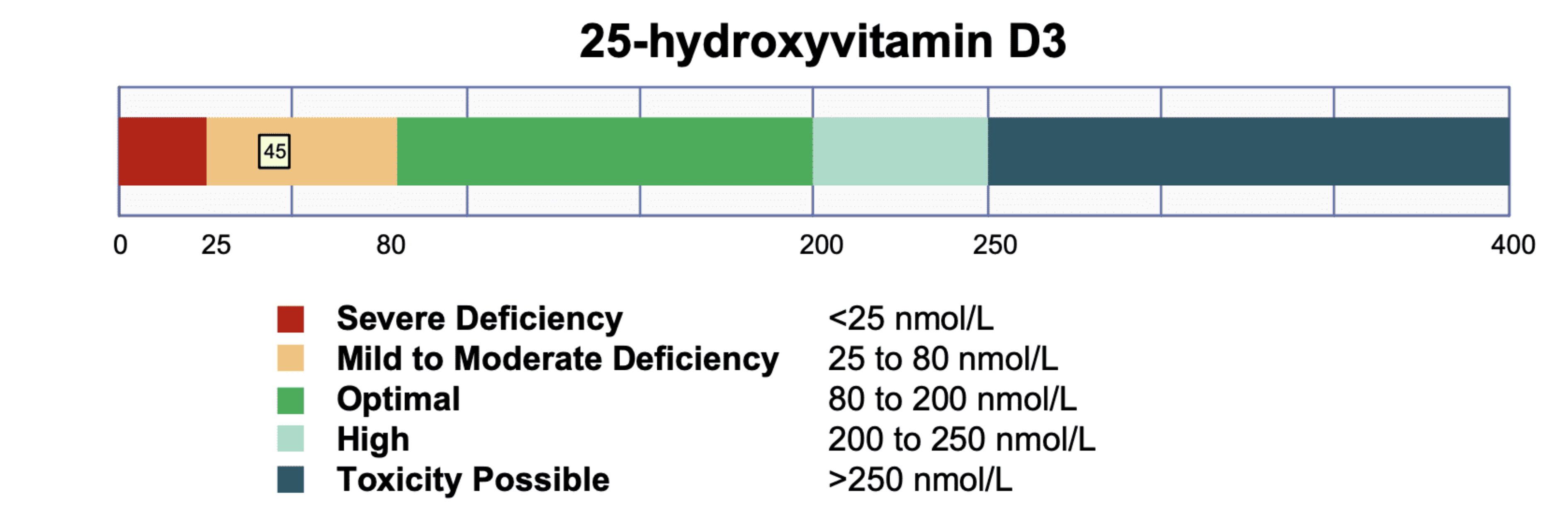
Por electroquimioluminiscencia

- Valor normal: > 30ng/ml

Otra medición: nmol/L

- Valor normal: > 80nmol/L


Status
Deficient
Insufficient
Sufficient
Potential toxicity
20 ng/ml
30 ng/ml
100 ng/ml
References range of VIDAS 25 OH Vitamin D Total


25-hydroxyvitamin D3
45
0
25
80
200
250
400
Severe Deficiency <25 nmol/L
Mild to Moderate Deficiency 25 to 80 nmol/L
Optimal 80 to 200 nmol/L
High 200 to 250 nmol/L
Toxicity Possible >250 nmol/L

Ingesta Recomendada (adultos >18 a 19 años)	Canadá y EUA: 600 UI Australia y Nueva Zelanda: 200 UI Países Nórdicos: 300 UI Inglaterra: 400 UI OMS: 200 UI
Fuentes Dietéticas (UI/porción)	- Pescados grasos como salmón, caballa, sardina y atún (100-1,000 UI/ 100 g). - Champiñones irradiados (1,600 UI/100 g) - Leche fortificada (100 UI/240 mL) - Algunas marcas/tipos de margarina (8-80 UI/1 cda*) - Yogurt (100 UI/240 mL) - Leche de soya (100 UI/240 mL) - Jugo de frutas (100 UI/240 mL) - Cereal listo para comerse (40-100 UI/1 porción) - Yema de huevo (20-40 UI/1 pieza)
Niveles y rangos de referencia	25(OH)D sérico circulante es el marcador del nivel de vitamina D. - Deficiente: 25(OH)D <50 nmol/L (20 ng/mL) - Insuficiente: 25(OH)D <75-80 nmol/L (30-32 ng/mL) - Suficiente: 25(OH)D >75-80 nmol/L (30-32 ng/mL) - Óptimo: 25(OH)D = 100-250 nmol/L (40-100 ng/mL) - Tóxico: 25(OH)D >375 nmol/L (150 ng/mL) más hipercalcemia.
Signos y síntomas de deficiencia	Concentración paratiroidea elevada; debilidad ósea; dolor óseo; disminución de la densidad ósea; aumento del riesgo de fractura ósea; incomodidad y debilidad muscular; atrofia de fibras musculares tipo II; alta frecuencia de enfermedades infecciosas. Nota: los síntomas pueden parecerse a los de la fibromialgia y síndrome de fatiga crónica.
Signos y síntomas de toxicidad	Calcio sérico elevado, fatiga, estreñimiento, dolor de espalda, olvido, náusea, vómito. Las complicaciones por calcio sérico elevado de manera prolongada incluyen la calcificación en tejidos blandos, hipertensión y anormalidades en el ritmo cardiaco.

Tabla 1: Ingesta diaria recomendada de vitamina D, fuentes dietéticas, niveles, y signos y síntomas de deficiencia y toxicidad.

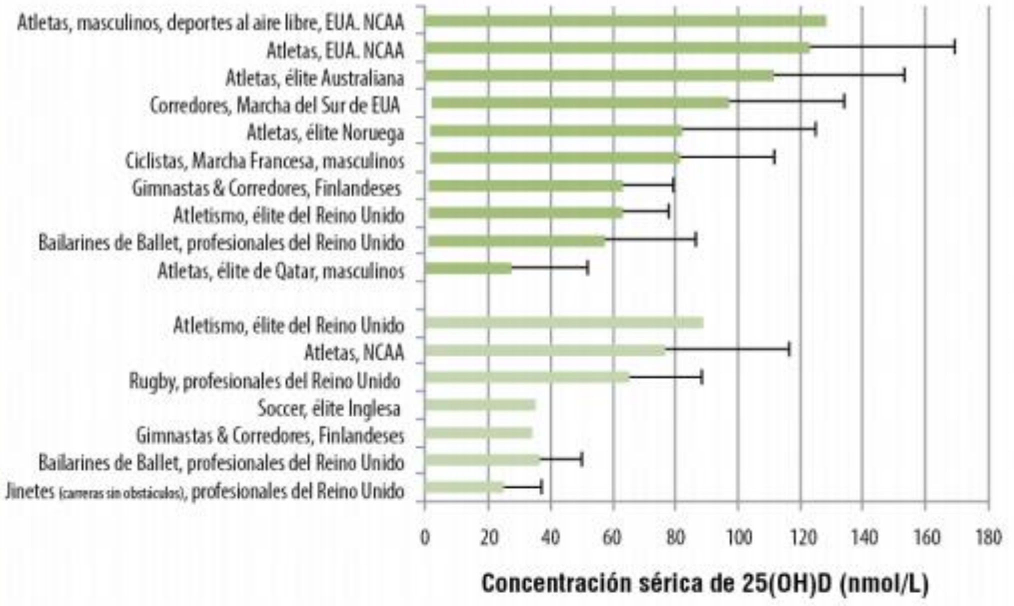


Figura 1: El nivel de vitamina D en atletas de distintos deportes en los meses soleados (gráfico superior, barras oscuras) y de invierno (gráfico inferior, barras más claras). NCAA, National Collegiate Athletic Association. Los datos representan atletas femeninas y masculinos a menos que se indique lo contrario. Las barras de error (si están presentes) representan la desviación estándar reportada. Desarrollado con base en las referencias de Bergen-Cico y Short, et al., 1992; Bescos Garcia y Rodriguez Guisado, 2011; Close et al., 2013; Halliday et al., 2011; Hamilton et al., 2010; Helle y Bjerkan, 2011; Lehtonen-Veromaa et al., 1999; Maimoun et al., 2006; Peeling et al., 2013; Pollock et al., 2012; Storlie et al., 2011; Willis et al., 2012; Wyon et al., 2014.

Factores que influyen en el estado

- ✓ Edad (síntesis se reduce ~ 75% a los 70 años)
- ✓ Pigmentación de la piel
- ✓ Grasa corporal
- ✓ Utilizar protector solar
- ✓ Ropa
- ✓ Contaminación atmosférica
- ✓ Hora del día
- ✓ Latitud > 35° norte o sur

¿Cómo y cuánto exponerse al sol?

- ✓ De 10 a 16 hs
- ✓ Sin protector solar
- ✓ Mínimo cara, cuello y brazos
- ✓ Exposiciones breves de 10 minutos
- ✓ 45 a 60 minutos semanales (en verano)
- ✓ Pieles oscuras deben exponerse más tiempo

15-20 minutos = 15,000 UI

Cantidad de Vitamina D en alimentos

TABLA 3. **Contenido en vitamina D de los alimentos**

Alimento	Contenido en vitamina D, UI
Leche de vaca	3-40/l
Leche/fórmulas infantiles reforzadas	400/l
Zumo de naranja/leche de soja/leche de arroz reforzada	400/l
Mantequilla	35/100 g
Margarina reforzada	60/cucharada
Yogur (normal, total o parcialmente descremado)	89/100 g
Queso *cheddar*	12/100 g
Queso parmesano	28/100 g
Queso suizo	44/100 g
Cereales reforzados	40/ración
Tofu reforzado (1/5 bloque)	120
Hongo shiitake fresco	100/100 g
Hongo shiitake desecado (no irradiado)	1.660/100 g
Yema de huevo	20-25/yema
Gambas	152/100 g
Hígado de ternera	15-50/100 g
Lata de atún/sardinas/salmón/caballa en aceite	224-332/100 g
Lata de salmón rosado con espinas en aceite	624/100 g
Salmón/caballa cocinado	345-360/100 g
Caballa del Atlántico (cruda)	360/100 g
Arenque del Atlántico (crudo)	1.628/100 g
Arenque ahumado	120/100 g
Arenque en escabeche	680/100 g
Bacalao (crudo)	44/100 g
Aceite de hígado de bacalao	175/g; 1.360 UI/cucharada

Adaptado de http://www.nal.usda.gov/fnic/foodcomp/Data/Other/vit_99.pdf

Ingesta Vitamina D en atletas

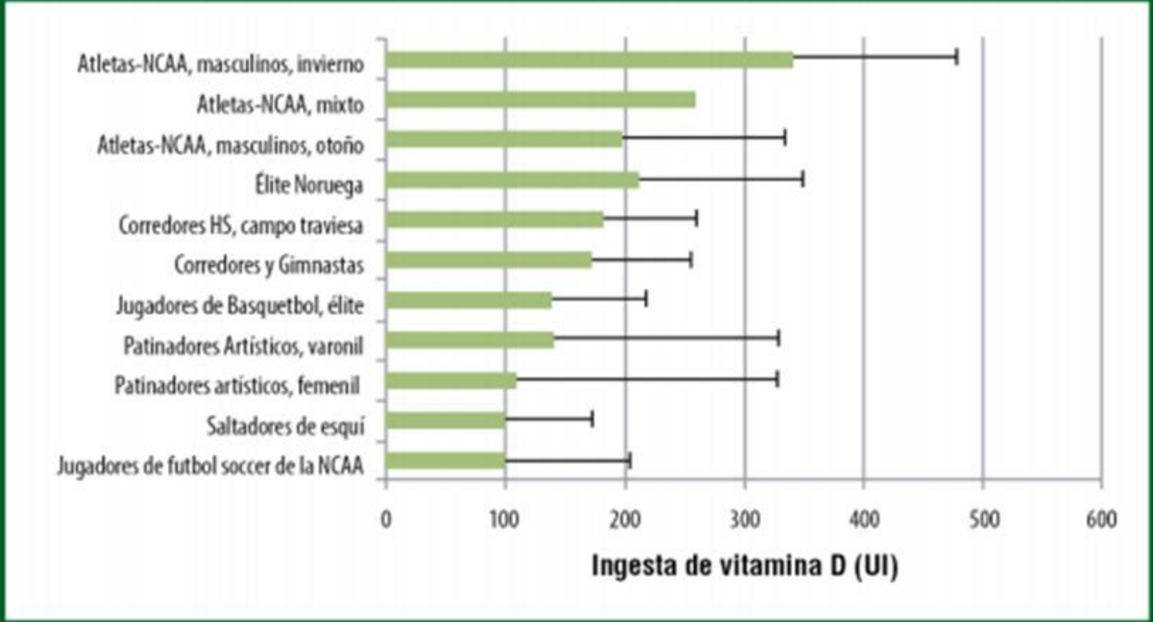


Figura 2: Ingesta de vitamina D en atletas de distintos deportes. NCAA, National Collegiate Athletic Association; HS, high school (preparatoria). Los datos representan atletas femeninas y masculinos a menos que se indique lo contrario. Las barras de error (si están presentes) representan la desviación estándar reportada. Desarrollado con base en las referencias de Bergen-Cico y Short, et al., 1992; Bescos Garcia y Rodriguez Guisado, 2011; Clark et al., 2003; Halliday et al., 2011; Helle y Bjerkan, 2011; Lehtonen-Veromaa et al., 1999; Rankinen et al., 1998; Storlie et al., 2011; Ziegler et al., 2001.

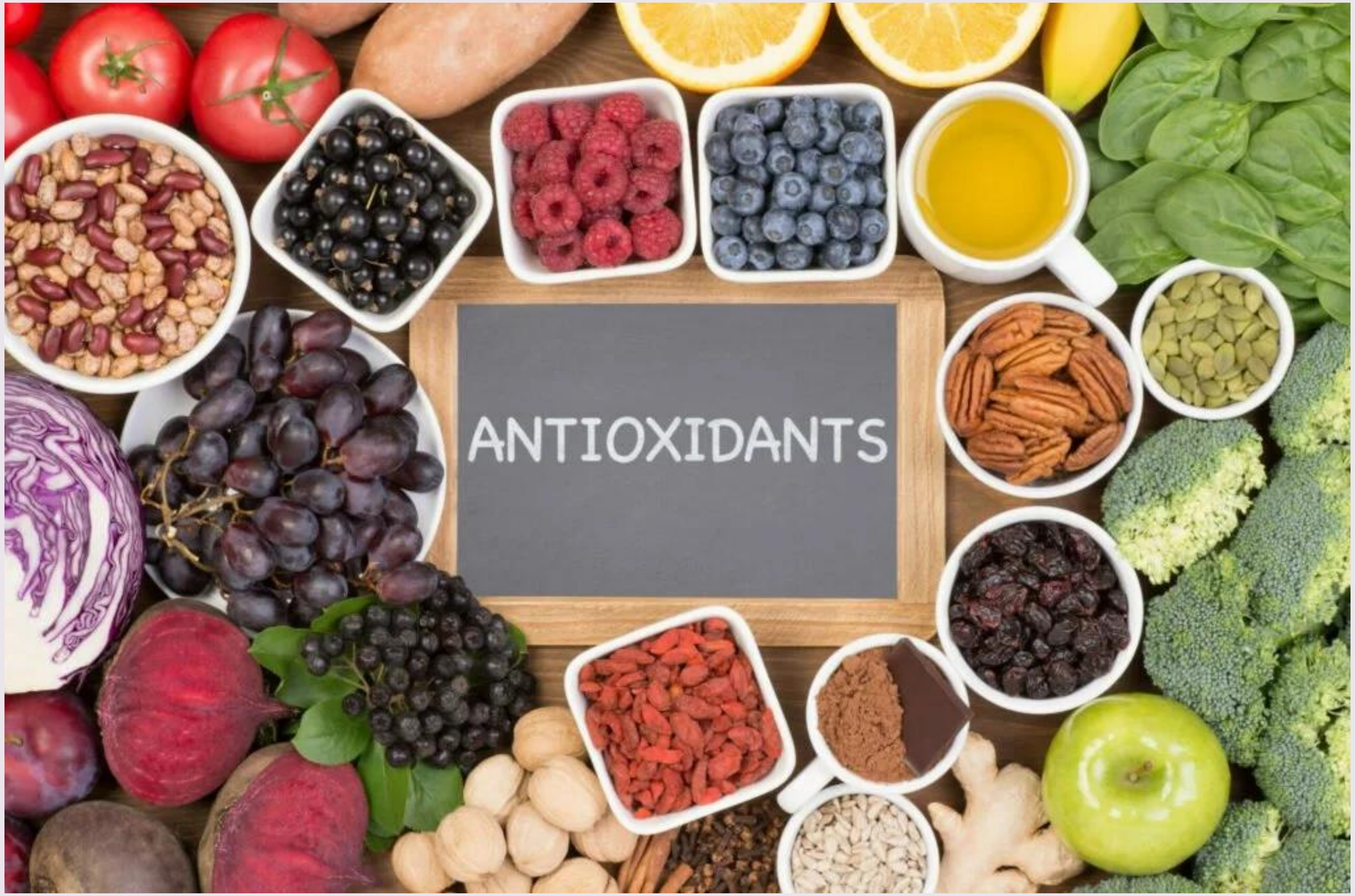
Hipervitaminosis D

- ✓ Vitamina D en sangre mayor a 150ng/ml (algunos sostienen que mayor a 100ng/ml ya es tóxico)
- ✓ Aportes diarios mayores a 10,000 UI por día
- ✓ Calcificación irreversible de tejidos blandos
- ✓ *Síntomas relacionados a la* ***hipercalcemia:*** náuseas, vómitos, estreñimiento, cálculos renales, anorexia, confusión, poliuria, polidipsia y debilidad muscular

Micronutrientes de especial Interés

- ~~Hierro (Fe)~~
- ~~Calcio~~
- ~~Vitamina D~~
- Antioxidantes
- Vitamina B12 – sólo en algunos grupos poblacionales

Antioxidantes



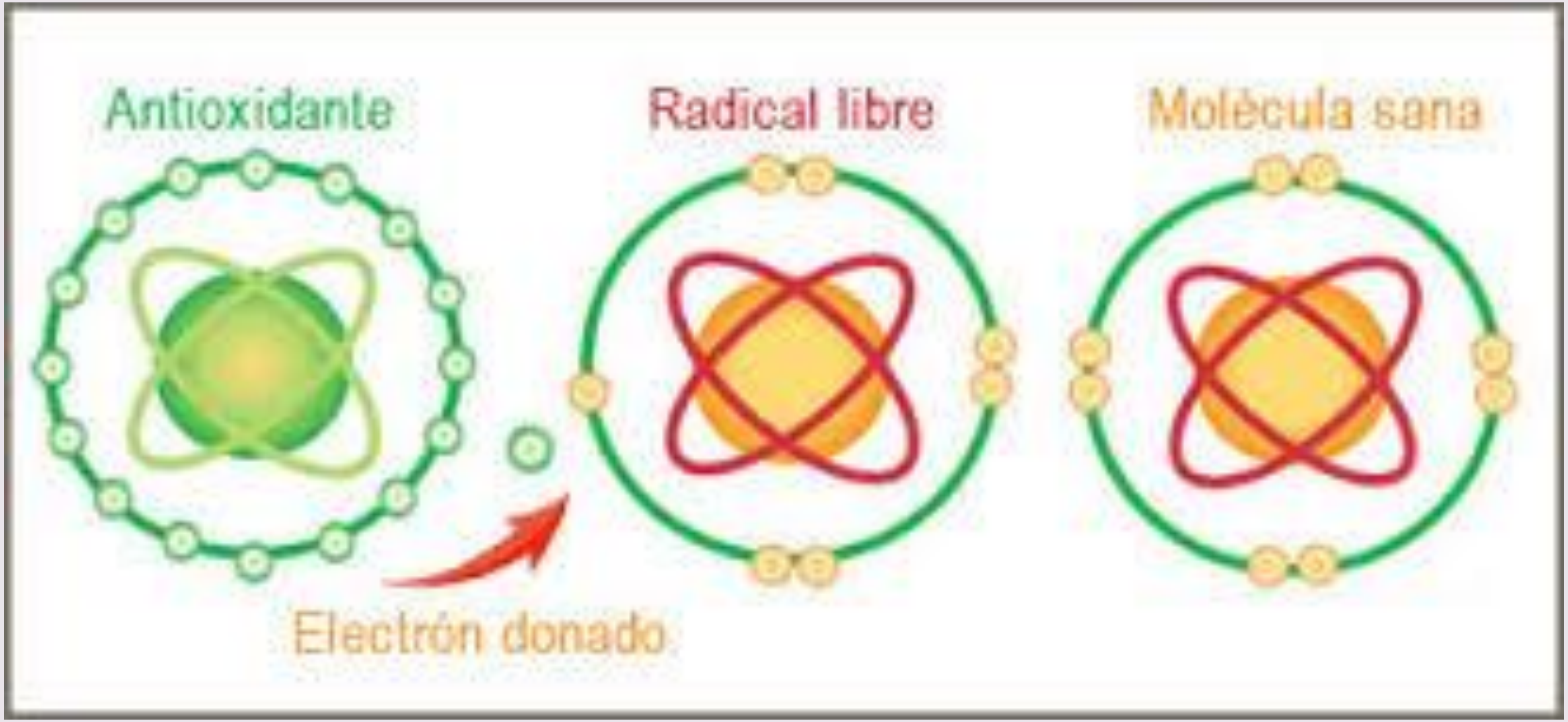
Principales Antioxidantes

- Vit C, Vit E, carotenos, selenio, zinc, cobre, manganeso…
- Fitoquímicos:
  - Licopeno
  - Luteínas
  - Xantófilas
  - Curcuminoides
  - Polifenoles
  - Cientos más…..

Función de los Antioxidantes

- Eliminan o neutralizan radicales libres
- Protección de las membranas celulares del daño oxidativo
- Ejercicio genera estrés oxidativo transitorio
- Pero… este estrés, genera estímulo adaptativo
- El uso de **suplementos** anti-oxidantes **atenúa esta respuesta adaptativa y sus beneficios**

¿Cómo funcionan los antioxidantes?



Letter To The Editor

Am J Physiol Endocrinol Metab 302: E476–E477, 2012;
doi:10.1152/ajpendo.00567.2011.

Antioxidant supplements in exercise: worse than useless?

Mari Carmen Gomez-Cabrera,[1] Michael Ristow,[2] and Jose Viña[1]

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TO THE EDITOR: In a recent paper by Higashida et al. (5), the authors report that very large doses of antioxidant vitamins do not prevent the exercise-induced adaptive responses of muscle mitochondria, GLUT4, and insulin action to exercise. As clearly stated in the paper, their data disagree with those reported by three independent research groups from Germany (14), Australia (17), and Spain (4).

Using a significantly different experimental protocol regard-

Suplementos antioxidantes en ejercicio: PEOR QUE INÚTILES?

found a very significant increase (~180%) in endurance time in rats after training (6 wk), which was dramatically blunted when the animals were supplemented with vitamin C (~26% increment). Endurance capacity is directly related to mitochondrial content, which is why we decided to determine the mitochondrial biogenesis cascade in skeletal muscle in our animals, and we found that it was significantly hampered. Although we found a dramatic effect of vitamin C on endurance time in animals, we did not find the same effect on $\dot{V}O_{2\,max}$ in either the animal study or the human study. This is clearly stated and discussed in the introduction, results, and discussion sections of our paper. However, Higashida et al. did not run any performance tests in their study; moreover, they misquoted a few times the results obtained in our human study. Training studies, including the data published by Higashida et

does not preserve muscle function but hinders the recovery process, thereby being detrimental to future performance (2). Finally, in our animal study, we found that vitamin C supplementation decreases training efficiency because it prevents exercise-induced mitochondrial biogenesis (4). Similar conclusions have been recently achieved by a US-based research group (6). The authors found that inhibition of a free radical-generating enzyme (xanthine oxidase) by allopurinol severely

ments and they concluded that beta carotene, vitamin A, and vitamin E supplementation seemed to increase the risk of death (1). This data confirmed previous reports showing that long-term vitamin E supplementation may increase the risk for heart failure in patients with vascular disease or diabetes mellitus (9). When a 6-wk aerobic exercise training program was applied in patients with hypertension, supplementation of antioxidants (vitamins C and E and α-lipoic acid) led to an enhancement of blood pressure and an inhibition of exercise-induced flow-mediated vasodilatation (19). Finally, one of us (M. Ristow) showed that antioxidant supplementation with vitamins C and E prevents the induction of molecular regulators of insulin sensitivity and endogenous antioxidant defense by physical exercise (14).

Randomized Controlled Trial > J Physiol. 2014 Apr 15;592(8):1887-901.
doi: 10.1113/jphysiol.2013.267419. Epub 2014 Feb 3.

Vitamin C and E supplementation hampers cellular adaptation to endurance training in humans: a double-blind, randomised, controlled trial

Gøran Paulsen [1], Kristoffer T Cumming, Geir Holden, Jostein Hallén, Bent Ronny Rønnestad, Ole Sveen, Arne Skaug, Ingvild Paur, Nasser E Bastani, Hege Nymo Østgaard, Charlotte Buer, Magnus Midttun, Fredrik Freuchen, Havard Wiig, Elisabeth Tallaksen Ulseth, Ina Garthe, Rune Blomhoff, Haakon B Benestad, Truls Raastad

El presente estudio contribuye a comprender cómo los antioxidantes pueden interferir con adaptaciones al ejercicio en humanos, y los resultados indican que altas dosis de vitaminas C y E deben usarse con precaución

daily for 11 weeks. During supplementation, the participants completed an endurance training programme consisting of three to four sessions per week (primarily of running), divided into high-intensity interval sessions [4-6 × 4-6 min; >90% of maximal heart rate (HRmax)] and steady state continuous sessions (30-60 min; 70-90% of HRmax). Maximal oxygen uptake (VO2 max), submaximal running and a 20 m shuttle run test were assessed and blood samples and muscle biopsies were

Randomized Controlled Trial › Scand J Med Sci Sports. 2016 Jul;26(7):755-63.
doi: 10.1111/sms.12506. Epub 2015 Jul 1.

Vitamin C and E supplementation blunts increases in total lean body mass in elderly men after strength training

T Bjørnsen [1], S Salvesen [1], S Berntsen [1], K J Hetlelid [1], T H Stea [1], H Lohne-Seiler [1], G Rohde [1], K Haraldstad [1], T Raastad [2], U Køpp [3], G Haugeberg [1], M A Mansoor [1], N E Bastani [4], R Blomhoff [4] [5], S B Stølevik [1], O R Seynnes [2], G Paulsen [2]

Affiliations + expand

La suplementación con altas dosis de vitamina C y E mitigó las adaptaciones musculares al entrenamiento de fuerza en hombres de edad avanzada

the same strength training program (three sessions per week). Body composition was assessed with dual-energy X-ray absorptiometry and muscle thickness by ultrasound imaging. Muscle strength was measured as one-repetition maximum (1RM). Total lean mass increased by 3.9% (95% confidence intervals: 3.0, 5.2) and 1.4% (0, 5.4) in the placebo and antioxidant groups, respectively, revealing larger gains in the placebo group ($P = 0.04$). Similarly, the thickness of m. rectus femoris increased

J Physiol. 2016 Sep 15; 594(18): 5135–5147.
Published online 2016 Jan 18. doi: 10.1113/JP270654
PMCID: PMC5023714
PMID: 26638792

Journal Article

Do antioxidant supplements interfere with skeletal muscle adaptation to exercise training?

Troy L. Merry[1,*] and Michael Ristow[1,*]

▸ Author information ▸ Article notes ▸ Copyright and License information PMC Disclaimer

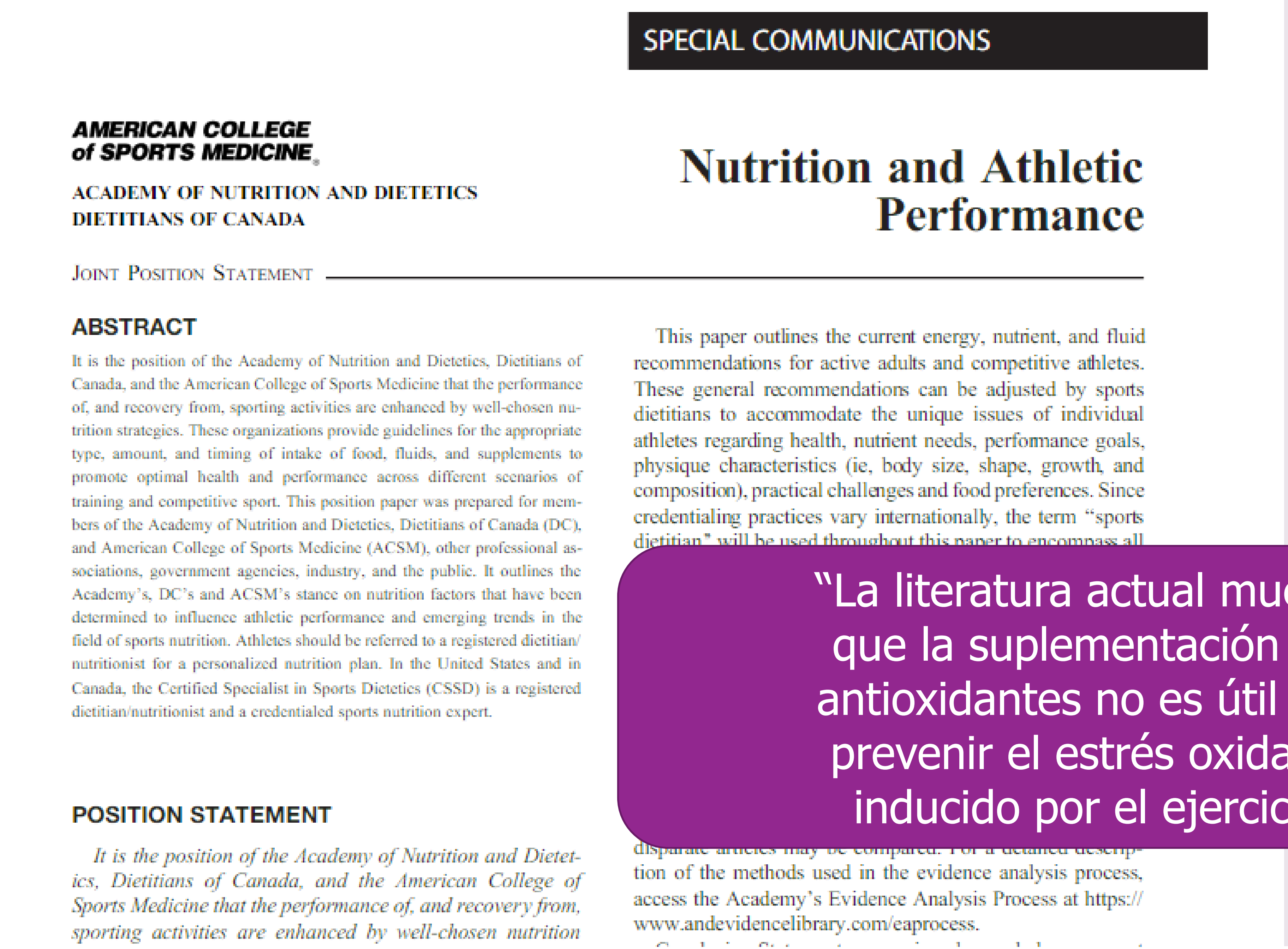
Abstract

Go to: ▸

"Dado el potencial de los antioxidantes para suprimir algunas adaptaciones al entrenamiento y con poca evidencia para sugerir algún efecto positivo, los autores tienden a rechazar el uso de tales suplementos"

mediated enhancements in antioxidant capacity, mitochondrial biogenesis, cellular defence mechanisms and insulin sensitivity. However, this is not a universal finding, potentially indicating that there is redundancy in the mechanisms controlling skeletal muscle adaptation to exercise,

al Article



SPECIAL COMMUNICATIONS

AMERICAN COLLEGE of SPORTS MEDICINE

ACADEMY OF NUTRITION AND DIETETICS
DIETITIANS OF CANADA

Nutrition and Athletic Performance

JOINT POSITION STATEMENT

ABSTRACT

It is the position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine that the performance of, and recovery from, sporting activities are enhanced by well-chosen nutrition strategies. These organizations provide guidelines for the appropriate type, amount, and timing of intake of food, fluids, and supplements to promote optimal health and performance across different scenarios of training and competitive sport. This position paper was prepared for members of the Academy of Nutrition and Dietetics, Dietitians of Canada (DC), and American College of Sports Medicine (ACSM), other professional associations, government agencies, industry, and the public. It outlines the Academy's, DC's and ACSM's stance on nutrition factors that have been determined to influence athletic performance and emerging trends in the field of sports nutrition. Athletes should be referred to a registered dietitian/nutritionist for a personalized nutrition plan. In the United States and in Canada, the Certified Specialist in Sports Dietetics (CSSD) is a registered dietitian/nutritionist and a credentialed sports nutrition expert.

POSITION STATEMENT

It is the position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine that the performance of, and recovery from, sporting activities are enhanced by well-chosen nutrition

This paper outlines the current energy, nutrient, and fluid recommendations for active adults and competitive athletes. These general recommendations can be adjusted by sports dietitians to accommodate the unique issues of individual athletes regarding health, nutrient needs, performance goals, physique characteristics (ie, body size, shape, growth, and composition), practical challenges and food preferences. Since credentialing practices vary internationally, the term "sports dietitian" will be used throughout this paper to encompass all

disparate articles may be compared. For a detailed description of the methods used in the evidence analysis process, access the Academy's Evidence Analysis Process at https://www.andevidencelibrary.com/eaprocess.

"La literatura actual muestra que la suplementación con antioxidantes no es útil para prevenir el estrés oxidativo inducido por el ejercicio"

Micronutrientes de especial Interés

- ~~Hierro (Fe)~~
- ~~Calcio~~
- ~~Vitamina D~~
- ~~Antioxidantes~~
- Vitamina B12 – sólo en algunos grupos poblacionales

Vitamina B12

Recomendación diaria

Niños	
De 0 a 6 meses	0,4 mcg/día
De 7 a 12 meses	0,5 mcg/día
De 1 a 3 años	0,9 mcg/día
De 4 a 8 años	1,2 mcg/día
De 9 a 13 años	1,8 mcg/día

Adolescentes y adultos	
Hombres y mujeres de 14 años en adelante	2,4 mcg/día
Mujeres y adolescentes embarazadas	2,6 mcg/día
Mujeres y adolescentes lactantes	2,8 mcg/día

Cantidad de Vit B12 en alimentos

Alimento	g o ml	Medidas caseras	Folatos EFD (µg)	Vitamina B_{12} (µg)
1 pan (marraqueta)	100	1 unidad	300	0
Jugo de naranja	250	1 taza	110	0
Papaya	300	1 unidad grande	116	0
Lechuga cruda	50	1 taza	21	0
Espinaca, cocida	180	1 taza	263	0
Porotos cocidos	180	1 taza	255	0
Carne, 20% de grasa	85	1 trozo mediano	9	2,3
Leche, vaca 1% grasa	250	1 taza	13	1,1
Queso cheddar	28	1 trozo pequeño	5	0,2
Pescado, salmón cocinado	85	1 trozo mediano	13	2,8
Huevo entero cocido	50	1 unidad	22	0,6

Fuente: Tabla de composición de alimentos USDA. EFD: equivalentes de folato dietario. *En Chile, una unidad de pan aporta aproximadamente 180 µg de ácido fólico, equivalente a 300 µg EFD.

Deficiencia de B12

- ✓Defectos del Tubo Neural
- ✓Anemia Megaloblástica
- ✓Hiperhomocisteinemia, con posible consecuencia de accidente cerebro vascular
- ✓Desmielinización de sistema nervioso central y de nervios periféricos, parestesias, atrofia óptica, alteraciones de la memoria, deterioro cognitivo y progresión de Alzheimer
- ✓Alteraciones gastrointestinales

¿Quienes deben prestar atención?

- ✓Veganos que no ingieren suplementos de Vit. B12 tienen riesgo especialmente alto de deficiencia
- ✓Vegetarianos deben prestar atención al uso de los suplementos de Vit. B12 para garantizar una ingesta adecuada
- ✓Vegetarianos, independientemente del tipo de dieta vegetariana a la que adhieran, deben someterse a una prueba de detección de deficiencia de Vit. B12

Fuentes NO seguras de Vit. B12

- ✓Algas
- ✓Levadura nutricional NO fortificada
- ✓Alimentos fermentados
- ✓Espirulina

Fuentes SEGURAS de Vit B12

- ✓Alimentos fortificados con vitamina B12 (en su mayoría resultan procesados o ultraprocesados)
- ✓Suplementos

Si nuestra dieta es variada y con aporte de calorías suficiente, no debería haber problemas para cumplir los requerimientos diarios de micronutrientes