

# DXA para diagnóstico de la osteoporosis

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**XXXII CONGRESO**  
DE LA  
SOCIEDAD CHILENA DE OSTEOLÓGÍA  
Y METABOLISMO MINERAL - SCHOMM

**25-26**  
ABRIL 2025

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Av. Pdte. Kennedy Lateral 4422  
Vitacura, Santiago



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Reumatología y  
Enfermedades Óseas



# Datos sociodemográficos LATAM

LA POBLACIÓN MUNDIAL ENVEJECE CON MAYOR RAPIDEZ QUE EN EL PASADO. LA ESPERANZA DE VIDA EN LA REGIÓN ALCANZÓ LOS 76.5 AÑOS DURANTE LA ÚLTIMA DÉCADA (2010-2020); UN AUMENTO DE POCO MÁS DE UN AÑO EN PROMEDIO.

La Comisión Económica para América Latina (CEPAL) incluye un total de 20 países en la región de América Latina: Argentina, Estado Plurinacional de Bolivia, Brasil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Haití, Honduras, México, Nicaragua, Panamá, Paraguay, Perú, República Bolivariana de Venezuela, República Dominicana y Uruguay). El presente estudio incluye 19 países de la región que representan el 98.2% de la población total de América Latina según la CEPAL.

La población total de este conjunto de países es de 630,534 millones de habitantes, lo que representa un aumento de 68,097 millones con respecto al 2012, que corresponde a un aumento del 10,8%.

Entre los países con mayor población se destacan Brasil con 212.5 millones y México con 128.9 millones de habitantes, mientras que los países con menor población son: Panamá con 4.3 millones y Uruguay con tan solo 3.4 millones de habitantes (Figura 1).



Datos: CEPAL 2021  
LATAM AUDIT 2021 - IOF

Tabla 1. Población total y ≥ 50 años en 2010 y 2020 (en millones de habitantes)

| PAÍSES                                                                                  | POBLACIÓN TOTAL 2010 | ≥ 50 AÑOS 2010 (%) | ≥ 50 AÑOS 2020 (%) |
|-----------------------------------------------------------------------------------------|----------------------|--------------------|--------------------|
| ARGENTINA                                                                               | 40,896               | 9,755 (23,9)       | 11,446 (25,4)      |
| BOLIVIA                                                                                 | 10,049               | 1,567 (15,6)       | 2,094 (17,9)       |
| BRASIL                                                                                  | 195,714              | 38,804 (19,8)      | 54,278 (25,5)      |
|  CHILE | 17,063               | 4,185 (24,5)       | 5,674 (29,7)       |
| COLOMBIA                                                                                | 45,223               | 8,492 (19,8)       | 12,241 (24)        |

Tabla 2. Esperanza de vida en Latinoamérica: 2010, 2020 y 2050 (en años)

| PAÍS                                                                                     | 2010 | 2020 | 2050 |
|------------------------------------------------------------------------------------------|------|------|------|
| ARGENTINA                                                                                | 76   | 77   | 81,6 |
| BOLIVIA                                                                                  | 69   | 72   | 77,9 |
| BRASIL                                                                                   | 74   | 77   | 82,1 |
|  CHILE | 79   | 81   | 85,5 |
| COLOMBIA                                                                                 | 76   | 78   | 82,8 |
| LATINOAMÉRICA                                                                            | 74,9 | 76,5 | 81,3 |

Datos: CEPAL 2021  
LATAM AUDIT 2021 - IOF

# Fracturas de Cadera

Mundo



Las fracturas de cadera son frecuentes en personas mayores de 60 años y presentan **alta morbilidad y mortalidad asociada**

2000

**1.6 millones**  
personas por año en el mundo

*9 millones de fracturas osteoporóticas*

2050

**6.3 millones**  
personas por año en el mundo

*Johnell O, Kanis JA. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporos Int. 2006; 17: 1726-33*

# Fracturas de Cadera

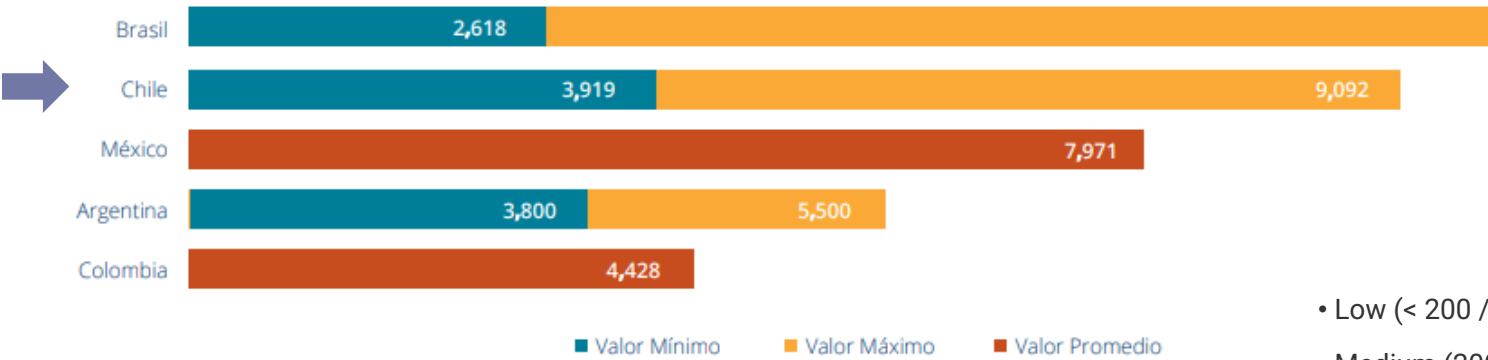
LATAM



Tabla 3. Tasas de fractura de cadera por 100,000 habitantes de ≥50años, en Brasil, Chile, Colombia, México y Perú

| PAÍS         | TASA DE FRACTURAS DE CADERA POR 100,000 HABITANTES |       |       |       |       |
|--------------|----------------------------------------------------|-------|-------|-------|-------|
|              | 2015                                               | 2016  | 2017  | 2018  | 2019  |
| BRASIL*      | 115.4                                              | 118.5 | 119.8 | 122.8 | 127.1 |
| CHILE*       | 144.7                                              | 148.4 | 150.0 | 146.2 |       |
| COLOMBIA**   | 132.5                                              | 118.2 | 149.2 | 203.8 | 265.9 |
| MEXICO IMSS& | 121                                                | 126   | 118   | 111   |       |
| MEXICO SS®   | 79.5                                               | 76.9  | 66.2  | 65.5  | 63.92 |
| PERU&        | 116.0                                              | 131.5 | 111.9 | 142.5 |       |

Figura 3. Costo de fractura de cadera por evento por país (en USD)



- Low (< 200 / 100 000)
- Medium (200-300 / 100 000)
- High (>300 / 100 000)

# Fracturas vertebrales



Entre la **población caucásica**, alrededor del **50% de las mujeres** y del **20% de los hombres** de 50+ años **sufrirán una fractura por fragilidad** en lo que le quede de vida.<sup>6</sup>

La **fractura vertebral** es el **tipo más común de fractura relacionada con la osteoporosis**.<sup>1-4</sup>

La **incidencia de fractura vertebral** en personas de ambos sexos de 50+ años aumenta con la edad y es **superior en las mujeres** que en los hombres.<sup>7</sup>

Johnell O and Kanis JA. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. *Osteoporos Int* 2006

Samelson EL, et al. Incidence and risk factors for vertebral fracture in women and men: 25-year follow-up results from the population-based Framingham study. *J Bone Miner Res*. 2006

# INCIDENCIA ACUMULATIVA DE NUEVAS FRACTURAS AL AÑO, 2 AÑOS Y 5 AÑOS DE UNA FRACTURA INICIAL

**Los pacientes con fracturas por fragilidad presentan mayor riesgo de nuevas fracturas**

| Initial fracture site | 1 year <sup>a</sup> |                                     | 2 years <sup>b</sup> |                                     | 5 years <sup>c</sup> |                                     |
|-----------------------|---------------------|-------------------------------------|----------------------|-------------------------------------|----------------------|-------------------------------------|
|                       | Number of patients  | % with subsequent fracture (95% CI) | Number of patients   | % with subsequent fracture (95% CI) | Number of patients   | % with subsequent fracture (95% CI) |
| Outcome: any fracture |                     |                                     |                      |                                     |                      |                                     |
| Any site              | 377,561             | 9.8 (9.7–9.9)                       | 210,621              | 17.9 (17.7–18.1)                    | 10,969               | 30.9 (30.0–31.7)                    |
| Spine                 | 111,382             | 14.1 (13.9–14.3)                    | 62,906               | 25.5 (25.2–25.9)                    | 3,349                | 40.1 (38.4–41.8)                    |
| Pelvis                | 23,113              | 11.8 (11.3–12.2)                    | 13,004               | 20.2 (19.5–20.9)                    | 673                  | 30.5 (27.0–33.9)                    |
| Clavicle              | 4,661               | 10.6 (9.7–11.5)                     | 2,509                | 18.3 (16.8–19.8)                    | 131                  | 33.6 (25.5–41.7)                    |
| Humerus               | 35,541              | 8.3 (8.0–8.6)                       | 19,546               | 15.7 (15.2–16.2)                    | 928                  | 31.8 (28.8–34.8)                    |
| Radius/ulna           | 56,265              | 7.2 (7.0–7.5)                       | 30,990               | 13.9 (13.5–14.3)                    | 1,492                | 29.4 (27.1–31.7)                    |
| Hip                   | 96,090              | 8.3 (8.1–8.5)                       | 53,987               | 15.0 (14.7–15.3)                    | 3,010                | 25.3 (23.8–26.9)                    |
| Femur                 | 12,615              | 7.3 (6.9–7.8)                       | 7,026                | 13.9 (13.1–14.7)                    | 365                  | 24.9 (20.5–29.4)                    |
| Tibia/fibula          | 12,212              | 6.9 (6.5–7.4)                       | 6,761                | 12.1 (11.4–12.9)                    | 363                  | 18.7 (14.7–22.7)                    |
| Ankle                 | 25,682              | 4.6 (4.4–4.9)                       | 13,892               | 9.5 (9.0–10.0)                      | 658                  | 21.0 (17.9–24.1)                    |

Balasubramanian A, et al. Risk of subsequent fracture after prior fracture among older women. *Osteoporos Int.* 2019;30(1):79-92.

# Prevención secundaria: Importancia del FLS

## Closing the Osteoporosis Care Gap

Kristina E. Åkesson<sup>1,2</sup> • Fiona E. A. McGuigan<sup>1,2</sup>

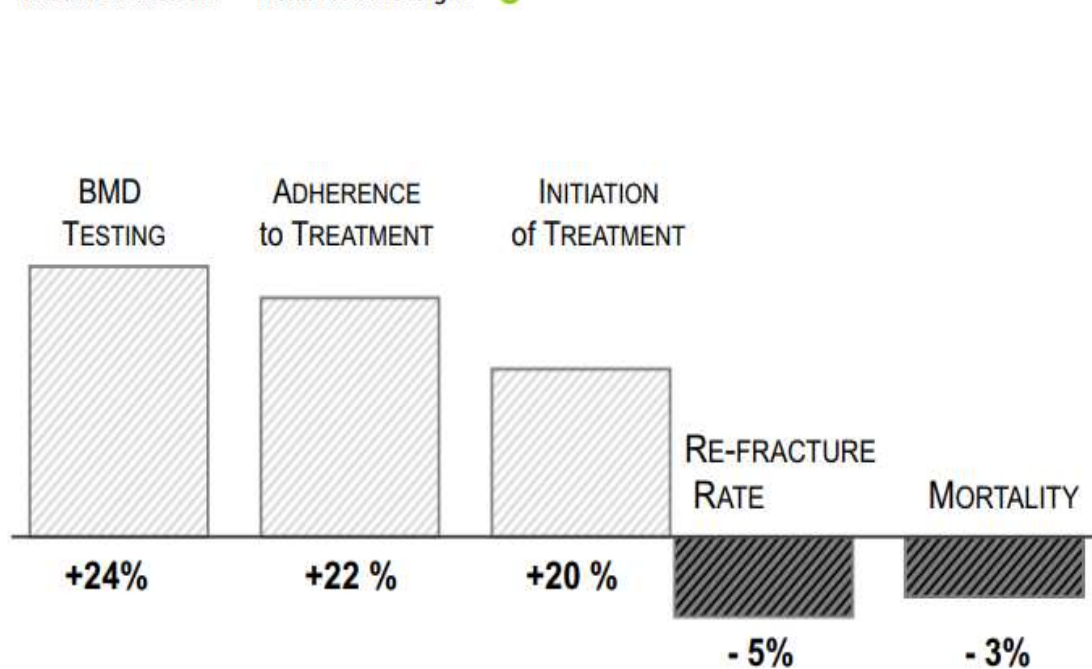
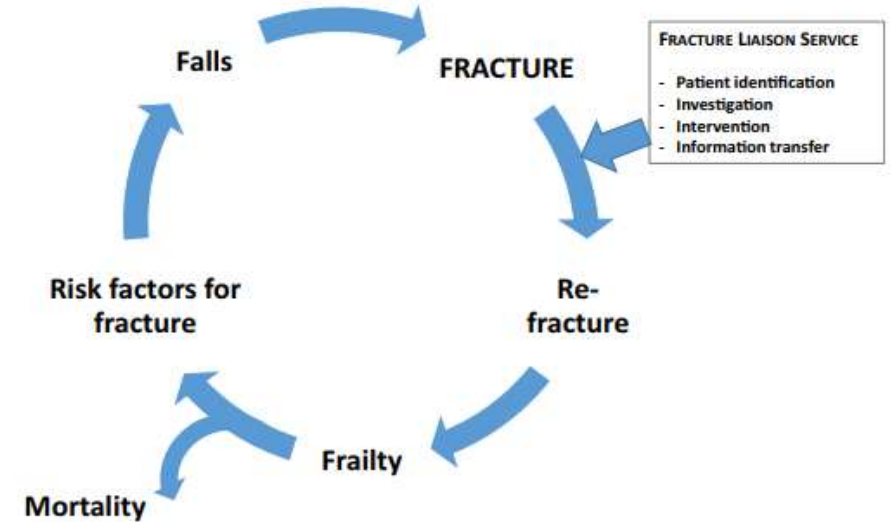
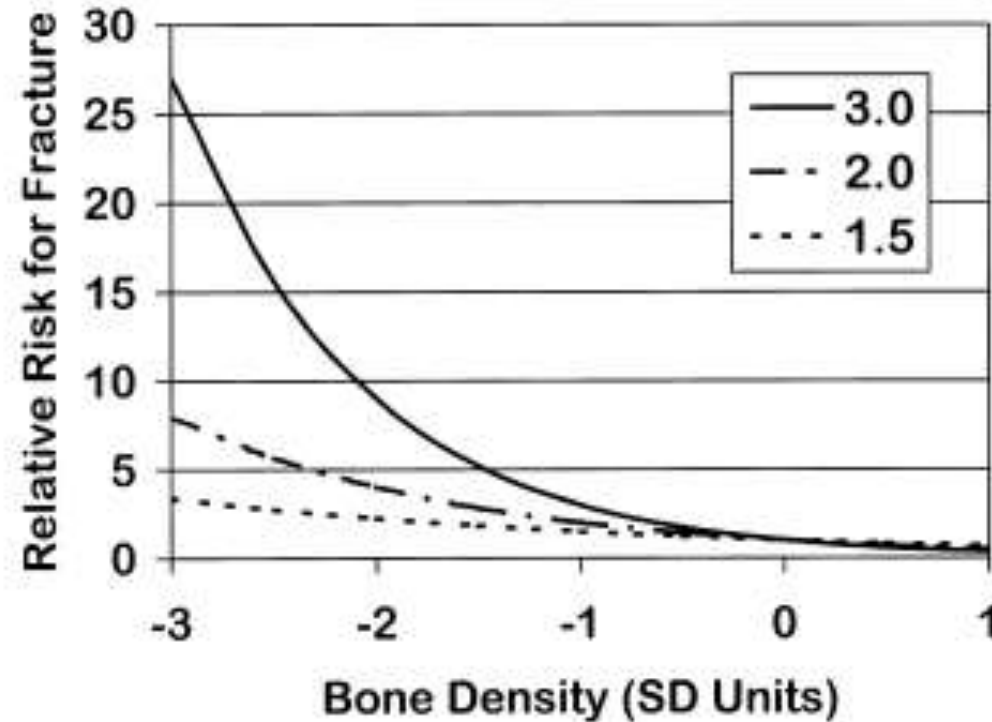


Fig. 3 Change in patient outcomes after osteoporosis-related fractures when managed through fracture liaison service (FLS) programmes



Åkesson y McGuigan *Current Osteoporosis Reports* (2021)

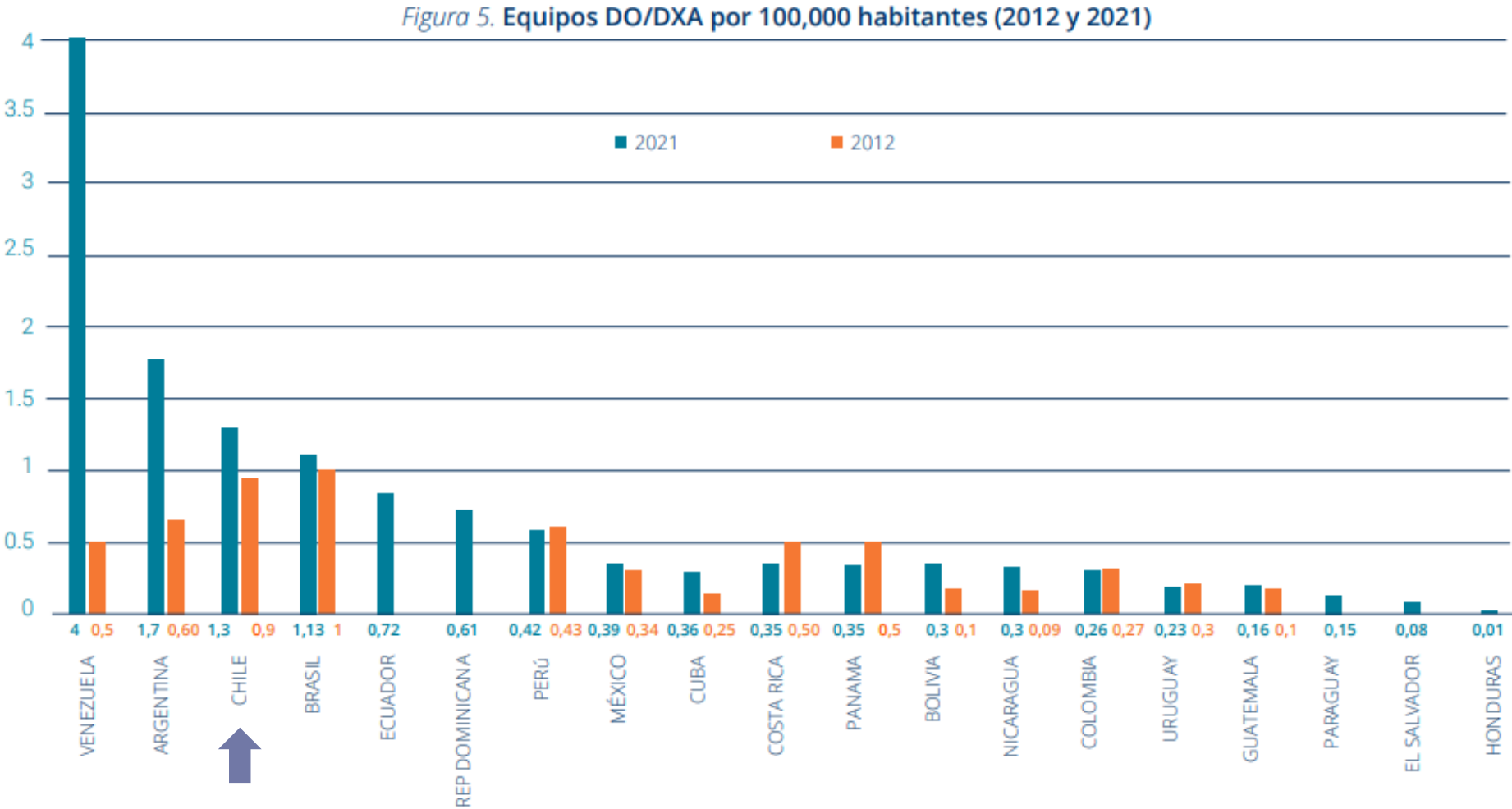
# La disminución de 1 SD en la DMO se asocia con un aumento de 1.5 a 3.0 veces en el riesgo de fractura osteoporótica.



**FIG. 1.** Exponential relationship between bone density and fracture risk. Curves are shown for odd's ratios of 1.5, 2.0, and 3.0 per SD change in bone density.

*Faulkner KG. Bone matters: are density increases necessary to reduce fracture risk? J Bone Miner Res. 2000;15(2):183-7.*

# Disponibilidad de densitómetros



A nivel internacional se ha estimado que la proporción adecuada de densitómetros disponibles para una población oscila entre 0,1 y 0,4 por 100,000 habitante (Kanis J, Johnell O. Requirements for DXA for the management of osteoporosis in Europe. Osteoporos Int 2005)

# Adult Official Positions of the ISCD

## Updated in 2023

### **Mujeres**

- Mujeres **de 65 años o más.**
- Mujeres **posmenopáusicas menores de 65 años** con factores de riesgo como:
  - Bajo peso corporal
  - Fractura previa
  - Uso de medicamentos de alto riesgo
  - Enfermedades o condiciones asociadas con pérdida ósea
- Mujeres en transición menopáusica con factores de riesgo clínicos de fractura:
  - Bajo peso corporal
  - Fractura previa
  - Uso de medicamentos de alto riesgo
- Mujeres que suspenden tratamiento con estrógenos.

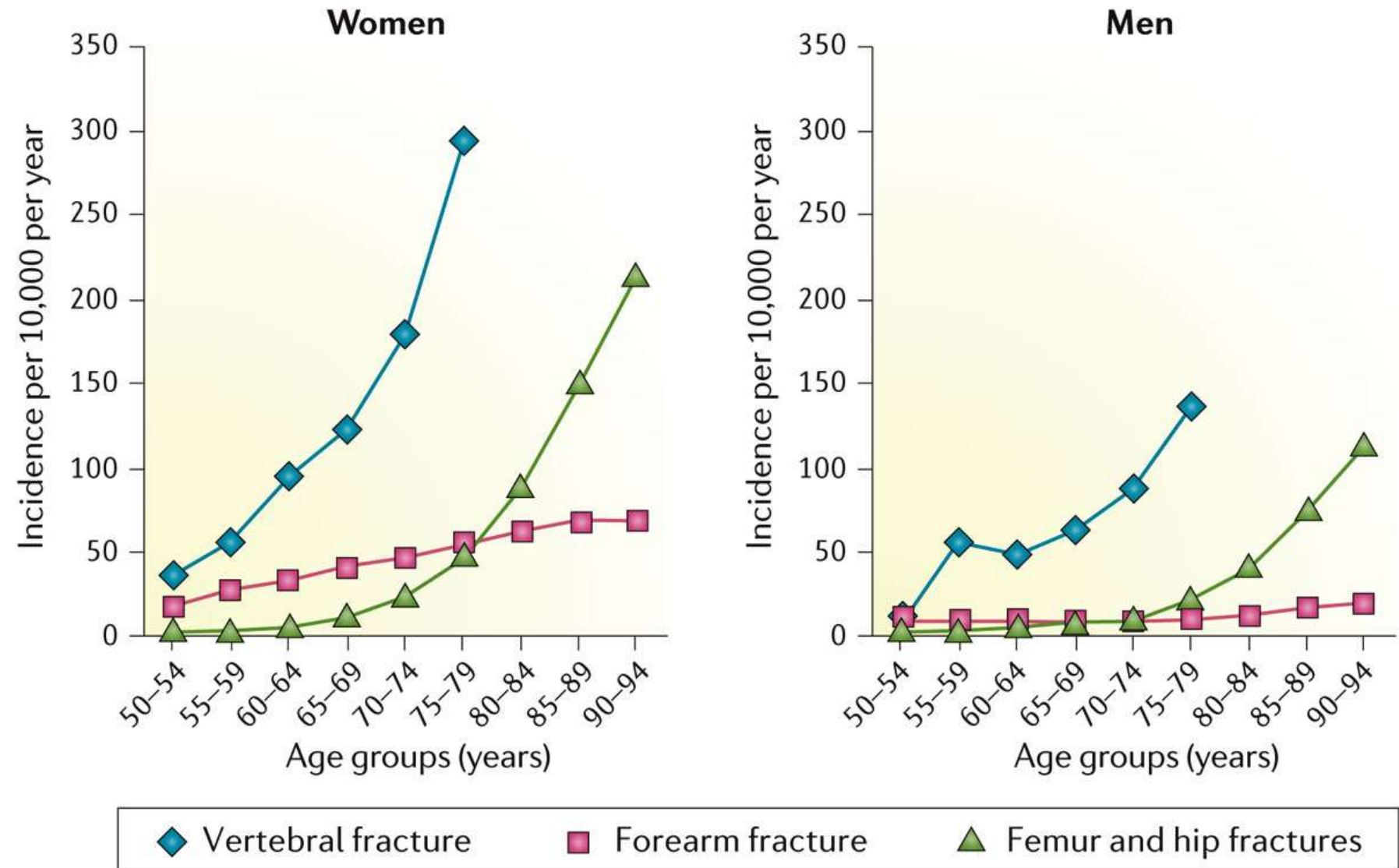
# Adult Official Positions of the ISCD

## Updated in 2023

### **Hombres**

- Hombres **de 70 años o más**.
- Hombres **menores de 70 años** con factores de riesgo como:
  - Bajo peso corporal
  - Fractura previa
  - Uso de medicamentos de alto riesgo
  - Enfermedades o condiciones asociadas con pérdida ósea

# INCIDENCIA DE FRACTURA SEGUN SEXO Y EDAD



Eastell, R. et al. (2016) Postmenopausal osteoporosis. Nat. Rev. Dis. Primers doi:10.1038/nrdp.2016.69

# Adult Official Positions of the ISCD

## Updated in 2023

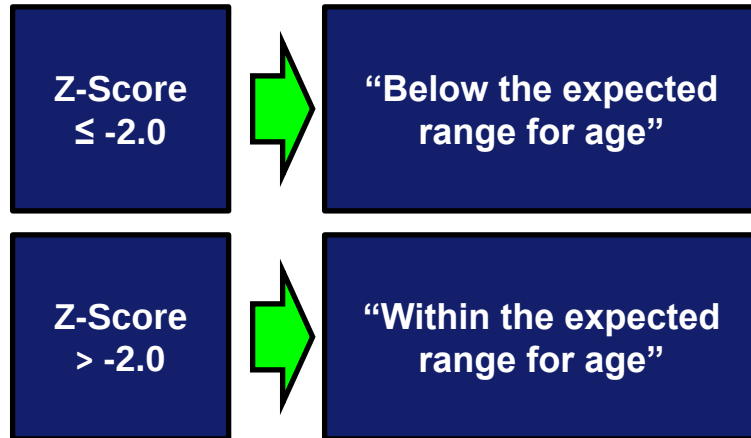
### Otras indicaciones

- Adultos con **fractura por fragilidad**.
- Adultos con **enfermedades o condiciones asociadas a pérdida de masa ósea**.
- Adultos que toman **medicamentos que afectan la densidad ósea**.
- Personas que van a **iniciar tratamiento farmacológico para osteoporosis**.
- Personas en **tratamiento**, para evaluar la **respuesta terapéutica**.
- Personas sin tratamiento, en quienes detectar pérdida ósea **cambiaría la decisión terapéutica**.



Mujeres premenopáusicas y  
hombres <50 años

Población pediátrica



Mujeres postmenopáusicas y  
hombres >50 años



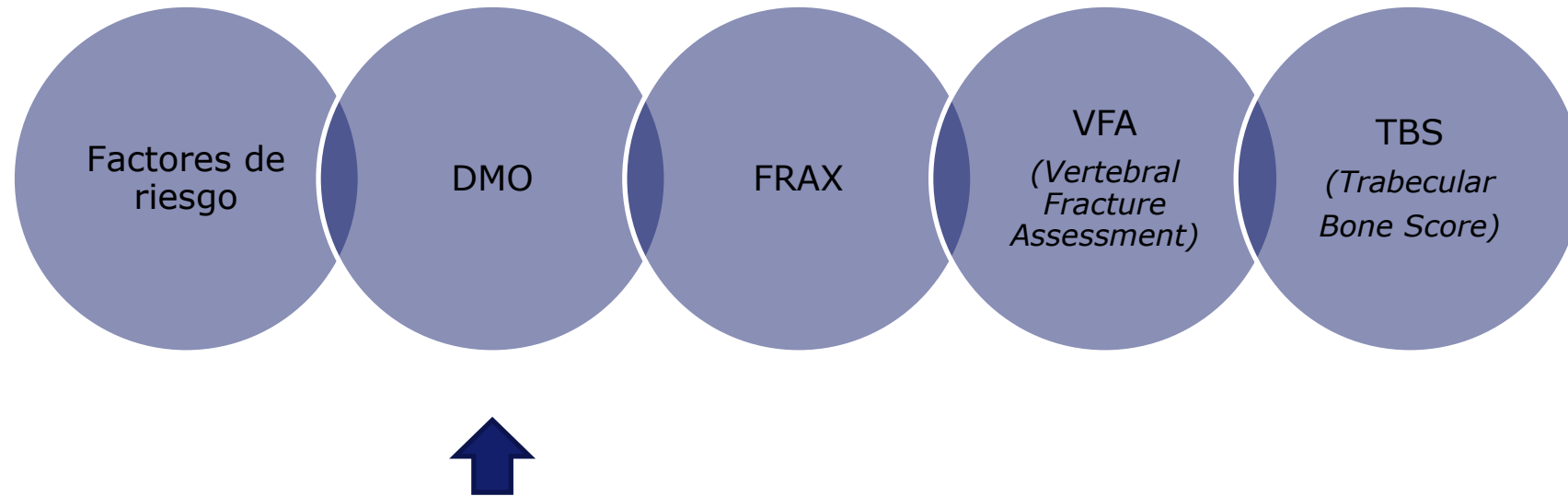
| Table 1<br>World Health Organization Diagnostic Criteria<br>for Women Without Fragility Fractures* |                                                                |
|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Diagnosis                                                                                          | BMD criteria                                                   |
| Normal                                                                                             | BMD value within 1 SD of the young adult mean                  |
| Osteopenia                                                                                         | BMD value between -1 SD and -2.5 SD below the young adult mean |
| Osteoporosis                                                                                       | BMD value at least -2.5 SD below the young adult mean          |
| *BMD = bone mineral density; SD = standard deviation.                                              |                                                                |

**Sitios:**

\*CL anteroposterior y cadera

\*Radio: si CL o cadera no pueden ser interpretado,  
Hiperparatiroidismo, Hiperobesos

# ESTRATIFICACIÓN DEL RIESGO DE FRACTURA



## Clinical Practice Guidelines

### AMERICAN ASSOCIATION OF CLINICAL ENDOCRINOLOGISTS/ AMERICAN COLLEGE OF ENDOCRINOLOGY CLINICAL PRACTICE GUIDELINES FOR THE DIAGNOSIS AND TREATMENT OF POSTMENOPAUSAL OSTEOPOROSIS— 2020 UPDATE

Pauline M. Camacho, MD, FACE<sup>1</sup>; Steven M. Petak, MD, JD, FACP, FCLM, MACE, CCD<sup>2</sup>;  
Neil Binkley, MD<sup>3</sup>; Dima L. Diab, MD, FACE, FACP, CCD<sup>4</sup>; Leslie S. Eldeiry, MD<sup>5</sup>;  
Azeez Farooki, MD<sup>6</sup>; Steven T. Harris, MD, FACP, FASBMR<sup>7</sup>; Daniel L. Hurley, MD, FACE<sup>8</sup>;  
Jennifer Kelly, DO, FACE<sup>9</sup>; E. Michael Lewiecki, MD, FACE, FACP, CCD<sup>10</sup>;  
Rachel Pessah-Pollack, MD, FACE<sup>11</sup>; Michael McClung, MD, FACP, FACE<sup>12</sup>;  
Sunil J. Wimalawansa, MD, PhD, MBA, FCCP, FACP, FRCP, DSc, FACE<sup>13</sup>;  
Nelson B. Watts, MD, FACP, CCD, FASBMR, MACE<sup>14</sup>

Camacho PM, et. al. American Association Of Clinical Endocrinologists/American College Of Endocrinology Clinical Practice Guidelines For The Diagnosis And Treatment Of Postmenopausal Osteoporosis- 2020 Update Executive Summary. *Endocr Pract.* 2020; 26(5):564-570.

## CLINICAL PRACTICE GUIDELINE UPDATE

### Pharmacological Management of Osteoporosis in Postmenopausal Women: An Endocrine Society Guideline Update

Dolores Shoback,<sup>1,2</sup> Clifford J. Rosen,<sup>3</sup> Dennis M. Black,<sup>4</sup>  
Angela M. Cheung,<sup>5,6</sup> M. Hassan Murad,<sup>7</sup> and Richard Eastell<sup>8</sup>

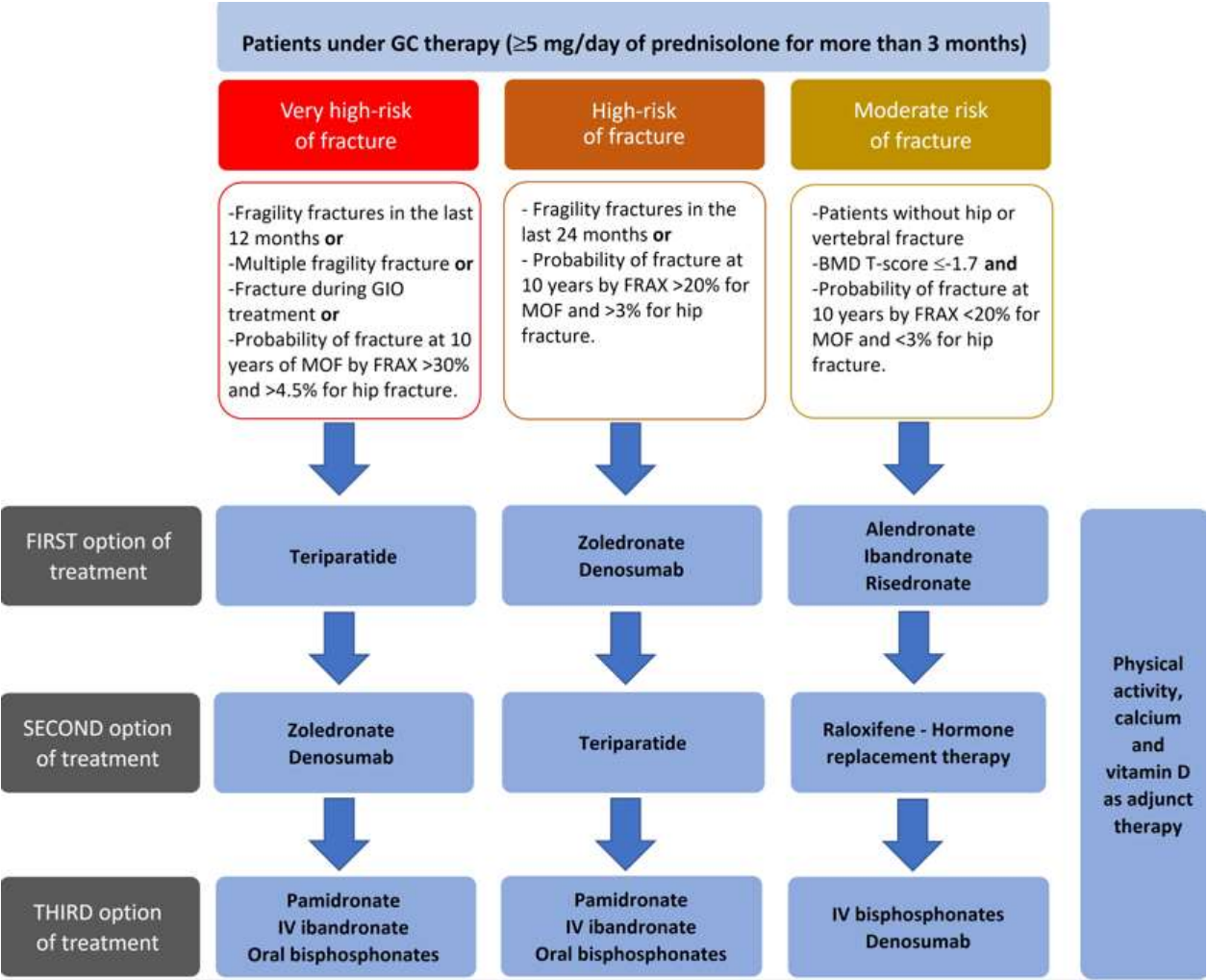
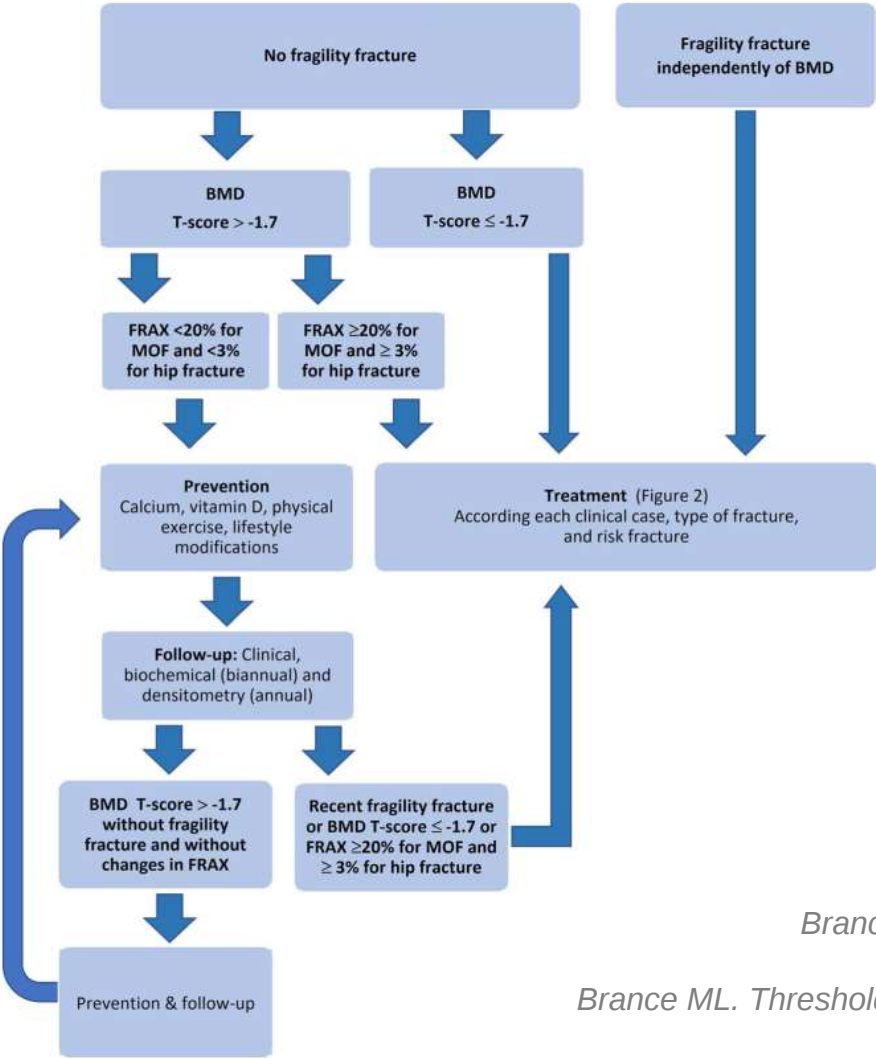
Shoback D, et al. Pharmacological Management of Osteoporosis in Postmenopausal Women: An Endocrine Society Guideline Update. *J Clin Endocrinol Metab.* 2020; 105(3):dgaa048.

# ESTRATIFICACIÓN DEL RIESGO DE FRACTURA

| VERY HIGH RISK                                                                                                                                                                                                                                                                              | HIGH RISK                                                                                                                                                                                                                                   | MODERATE RISK                                                                                                                                                             | LOW RISK                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| If one or more of the below are true                                                                                                                                                                                                                                                        | If some of the below are true                                                                                                                                                                                                               | If all of the below are true                                                                                                                                              | If all of the below are true                                                                                                                                                                                  |
| <ul style="list-style-type: none"><li>✓ Prior Fx within 12 months</li><li>✓ Multiple fragility Fx</li><li>✓ Fx while OP treatment</li><li>✓ Fx while on medication harmful to bone</li><li>✓ Very low T-Score &lt; -3</li><li>✓ 10 year FRAX probability &gt;30% MOF and &gt;4.5%</li></ul> | <ul style="list-style-type: none"><li>✓ Prior Fx in the last 24 months <b>or</b></li><li>✓ T-Score ≤ -2,5 (OP) <b>or</b></li><li>✓ T-Score -1 a -2,5 (Osteopenia) <b>and</b> 10 year FRAX probability &gt;20% MOF and &gt;3% hip.</li></ul> | <ul style="list-style-type: none"><li>✓ No prior Fx</li><li>✓ T-Score -1 y -2.5 (Osteopenia BMD)</li><li>✓ 10 year FRAX probability &lt;20% MOF and &lt;3% hip.</li></ul> | <ul style="list-style-type: none"><li>✓ Post menopausal women</li><li>✓ No prior Fx</li><li>✓ T-Score &gt;-1 (normal BMD) <b>and</b></li><li>✓ 10 year FRAX probability &lt;20% MOF and &lt;3% hip.</li></ul> |
| >30% MOF and >4.5%                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                             |                                                                                                                                                                           |                                                                                                                                                                                                               |

## POSTMENOPAUSAL OSTEOPOROSIS

# Mujeres postmenopáusicas y hombres mayores de 50 años bajo tratamiento con GCs



Brance ML, et al. Argentine Guidelines for the Prevention and Treatment of Glucocorticoid-Induced Osteoporosis in Postmenopausal Women and Men Aged 50 Years and Older. *J Clin Rheumatol*. 2023;29(5):e59-e70.

Brance ML. Threshold based on bone mineral density for therapeutic decision-making in postmenopausal women and men over 50 years old under glucocorticoid therapy. *Reumatol Clin (Engl Ed)*. 2023;19(5):279-284.

# Osteoporosis – DXA



DXA (*Dual-energy X-Ray Absorptiometry*)



**Aprobado a nivel mundial:**  
datos fácilmente disponibles



**Económico:** costo bajo



**Seguridad del paciente:**  
dosis de radiación muy baja

# ¿Qué esperar durante su escaneo DXA?

- **Escaneos rápidos:** en menos de 10 minutos se puede hacer tanto la cadera como la columna vertebral.
- **No invasivo e indoloro.**
- **Preparación del paciente:** ropa cómoda sin broches, botones o cremalleras de metal.
- **Rayos X de muy baja dosis (0,001 mSv):** equivalente a menos de un día de radiación de fondo o menos de la dosis en un vuelo de más de 6 horas de duración. (Rx tórax 0,1 mSv, TAC 7 mSv).

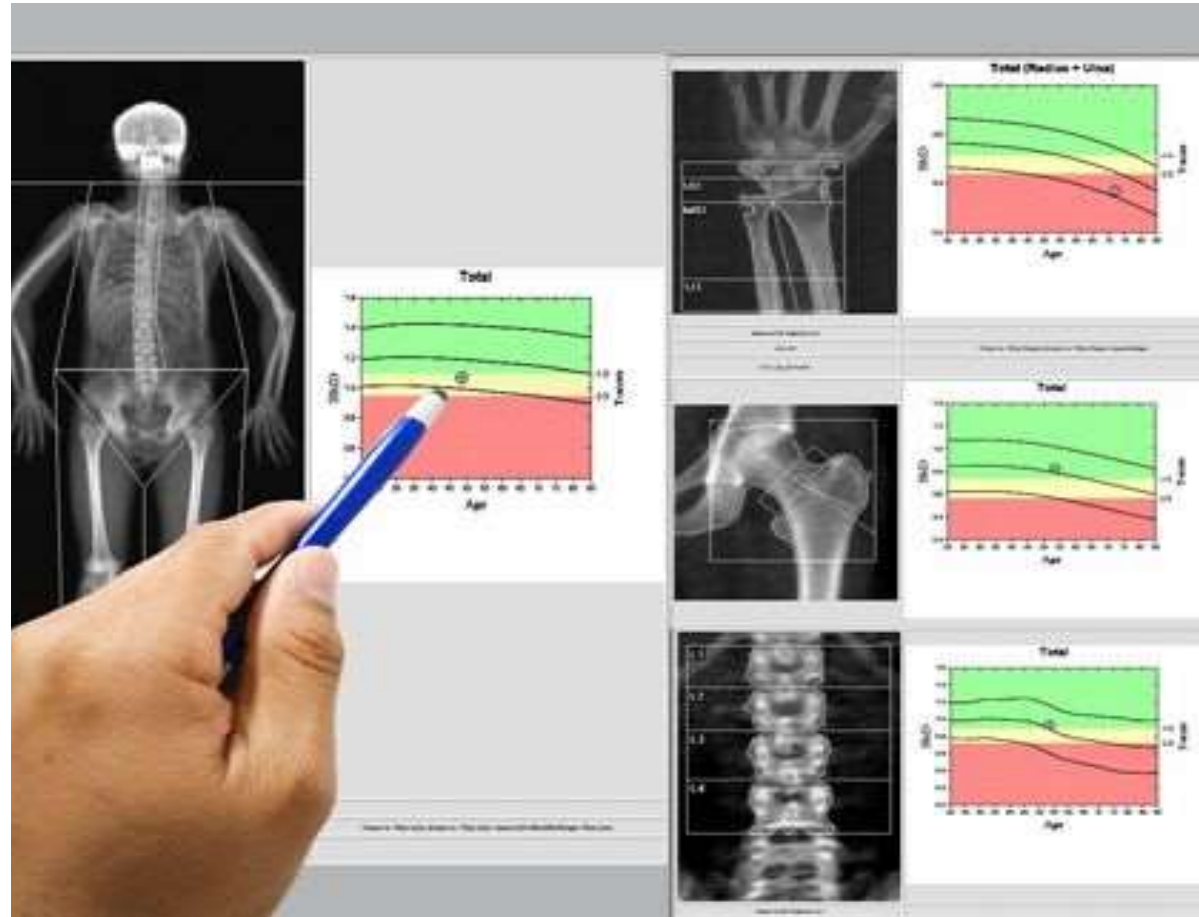


# Estudios que permite realizar

## Densidad Mineral Ósea (DMO)

Cuerpo Entero

Cuerpo Entero  
con selección de  
ROI específicos



Radio 33%

Cuello femoral  
y cadera total

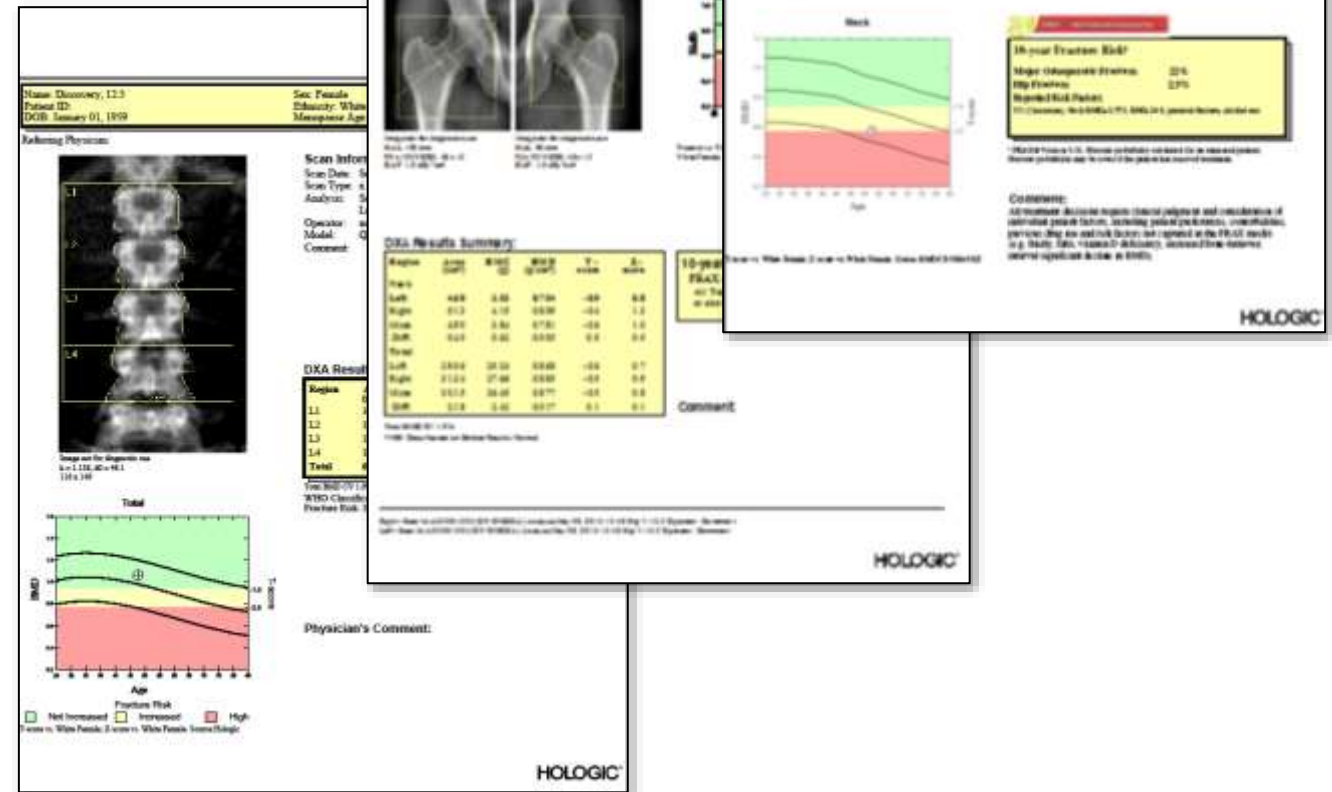
Columna Lumbar

Shuhart CR, Yeap SS, Anderson PA, et al. Executive Summary of the 2019 ISCD Position. J Clin Densitom. 2019; 22:453-471.

# Columna vertebral AP y fémur

## Exploraciones estándar

- AP Columna vertebral y cadera.
- Escaneo rápido
- Imágenes nítidas
- 1%CV
- Informes completos incluyendo FRAX®



# ¿Cómo garantizar una densitometría de calidad?

- **Posicionamiento**
- **Adquisición adecuada y completa.**
- **Análisis de la imagen DXA**
- **Equipo en óptimas condiciones**

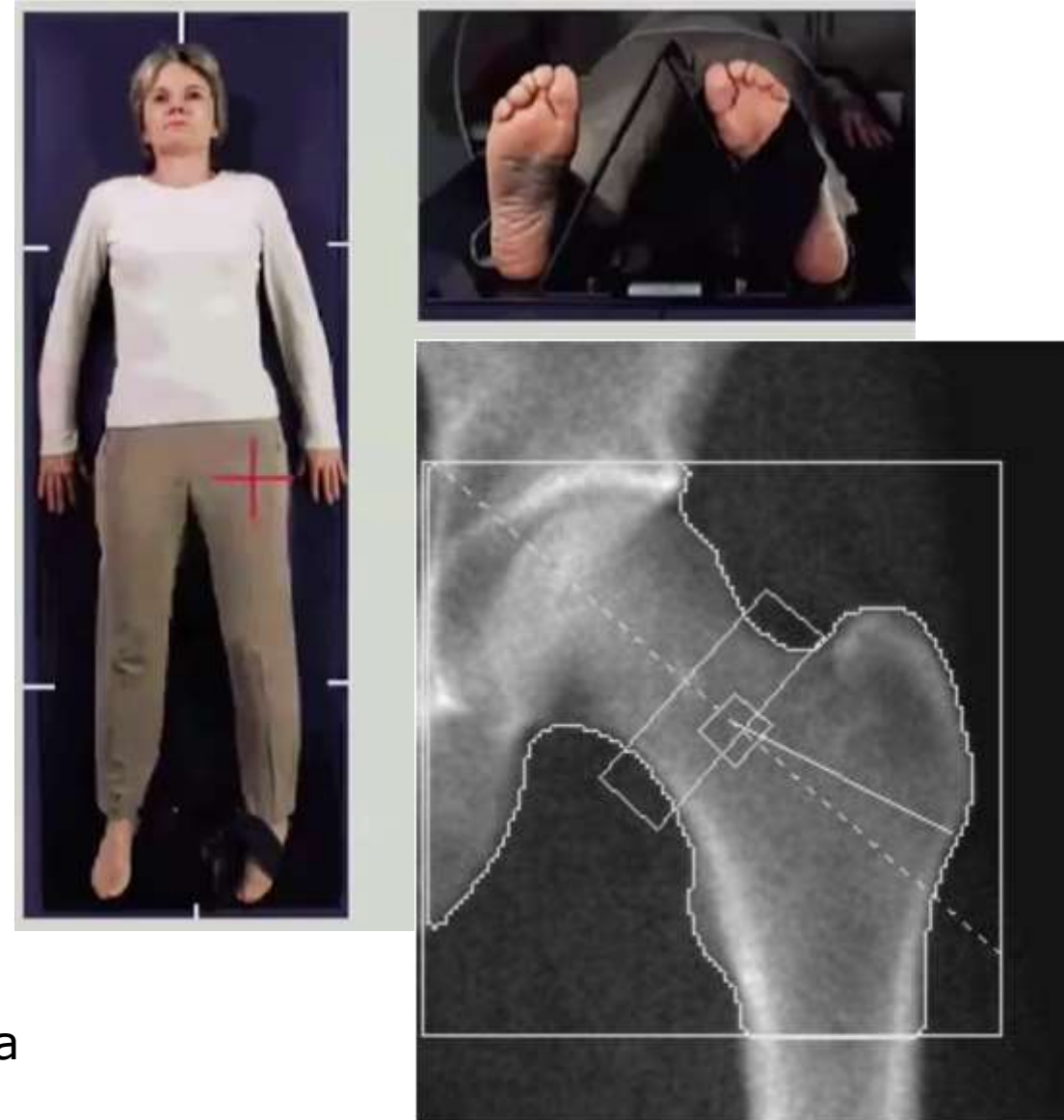


# COLOCACIÓN DEL PACIENTE Y ADQUISICIÓN DEL SCAN

- Diáfisis femoral recta
- Rotación interna femoral correcta
- Trocánter mayor centrado en el scan verticalmente
- No artefactos
- Trocánter menor pequeño o no se ve
- Paciente en decúbito supino con la pierna ligeramente en abducción y rotación interna (15-30°)
- Para **diagnóstico** usar el valor mas bajo de cuello femoral o cadera total
- Para **seguimiento** cadera total (mismo ROI)



$$\text{DMO} = \text{CMO} / \text{área} \quad (\text{g/cm}^2)$$



# COLOCACIÓN DEL PACIENTE Y ADQUISICIÓN DEL SCAN

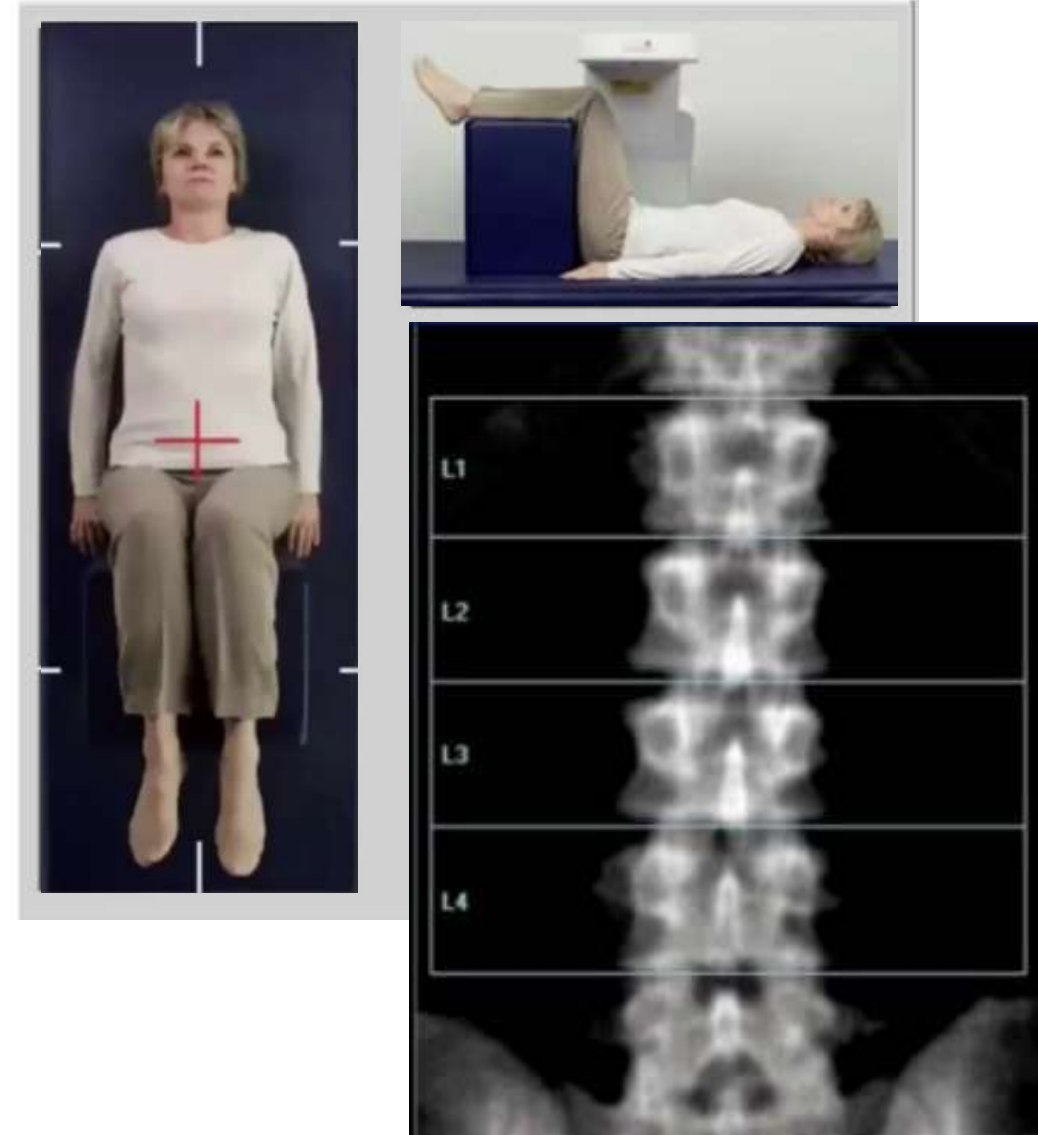
- Recto
- Centrado
- Incluye marcas anatómicas
- Sin movimientos y artefactos presentes
- Incluye toda la región de interés **L1-L4**

Sólo excluir

\*vértebras afectadas por cambios estructurales o por artefactos.

\*más de 1,0 T-score de diferencia entre la vértebra dudosa y la vértebra adyacente

Nunca utilizar 1 sola vértebra!!



Name: Sex: Female Height: 154.0 cm  
 Patient ID: Ethnicity: White Weight: 61.0 kg  
 DOB: Menopause Age: 40 Age: 73

Referring Physician: BRANCE Lorena

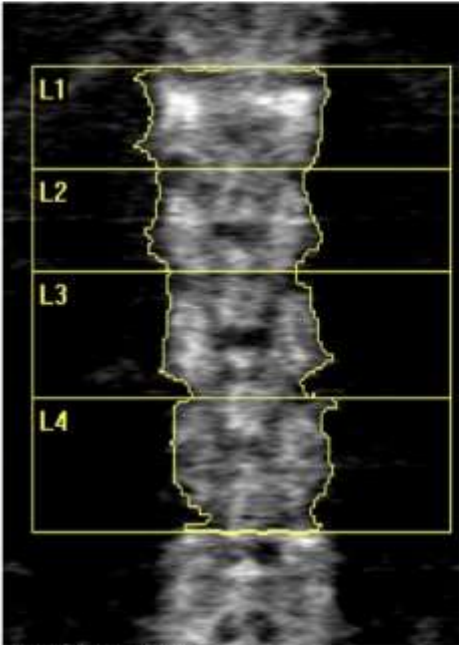


Image not for diagnostic use  
 k = 1.134, d0 = 43.8  
 116 x 119

L1-L4

Scan Information:

Scan Date: 01 December 2022 ID: A12012203  
 Scan Type: f Lumbar Spine  
 Analysis: 01 December 2022 08:45 Version 13.5.4:5  
 Spine  
 Operator:  
 Model: Discovery Wi (S/N 93053M)  
 Comment:

DXA Results Summary:

| Region | Area (cm²) | BMC (g) | BMD (g/cm³) | T - score | Z - score |
|--------|------------|---------|-------------|-----------|-----------|
| L1     | 12.74      | 12.38   | 0.972       | -0.2      | 1.9       |
| L2     | 11.44      | 10.07   | 0.880       | -1.3      | 0.9       |
| L3     | 13.12      | 11.18   | 0.852       | -2.1      | 0.3       |
| L4     | 14.10      | 11.80   | 0.837       | -2.0      | 0.4       |
| L1-L4  | 51.39      | 45.43   | 0.884       | -1.5      | 0.8       |
| L2-L4  | 38.65      | 33.04   | 0.855       | -2.0      | 0.3       |

Total BMD CV 1.0%, ACF = 1.042, BCF = 1.033, TH = 7.922  
 WHO Classification: Osteopenia  
 Fracture Risk: Increased

Name: Sex: Female Height: 154.0 cm  
 Patient ID: Ethnicity: White Weight: 61.0 kg  
 DOB: Menopause Age: 40 Age: 73

Referring Physician: BRANCE Lorena

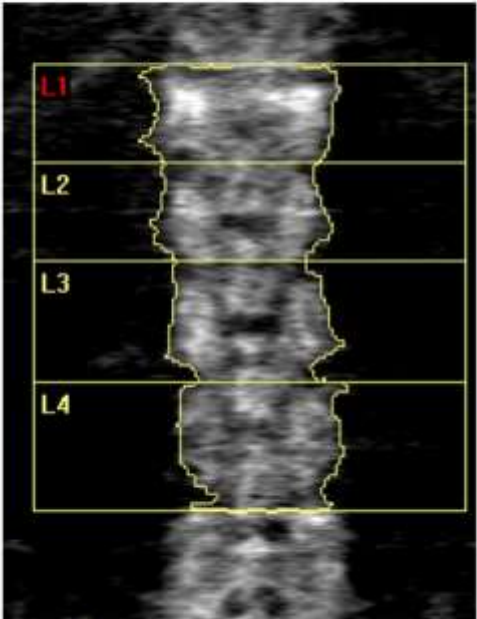


Image not for diagnostic use  
 k = 1.134, d0 = 43.8  
 116 x 119

Scan Information:

Scan Date: 01 December 2022 ID: A12012203  
 Scan Type: f Lumbar Spine  
 Analysis: 01 December 2022 08:46 Version 13.5.4:5  
 Spine  
 Operator:  
 Model: Discovery Wi (S/N 93053M)  
 Comment:

DXA Results Summary:

| Region | Area (cm²) | BMC (g) | BMD (g/cm³) | T - score | Z - score |
|--------|------------|---------|-------------|-----------|-----------|
| L2     | 11.44      | 10.07   | 0.880       | -1.3      | 0.9       |
| L3     | 13.12      | 11.18   | 0.852       | -2.1      | 0.3       |
| L4     | 14.10      | 11.80   | 0.837       | -2.0      | 0.4       |
| Total  | 38.65      | 33.04   | 0.855       | -2.0      | 0.3       |

Total BMD CV 1.0%, ACF = 1.042, BCF = 1.033, TH = 7.922  
 WHO Classification: Osteopenia  
 Fracture Risk: Increased

Referring Physician: BRANCE ML

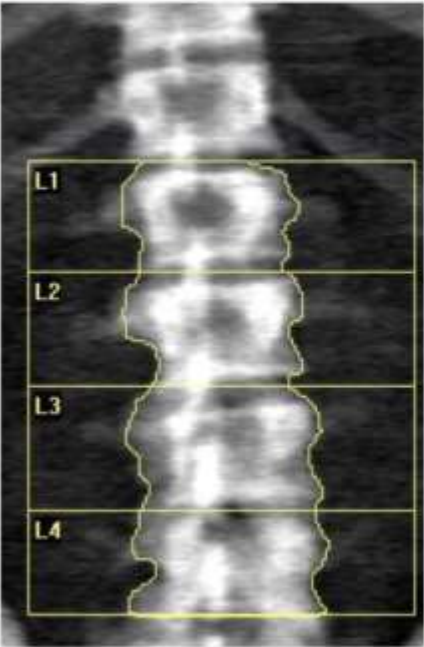


Image not for diagnostic use  
k = 1.130, d0 = 43.8  
116 x 136

L1-L4

Scan Information:

Scan Date:

17 May 2023

ID:

A05172306

Scan Type:

f Lumbar Spine

Analysis:

17 May 2023 11:51 Version 13.5.4:5

Lumbar Spine

Operator:

Model:

Discovery Wi (S/N 93053M)

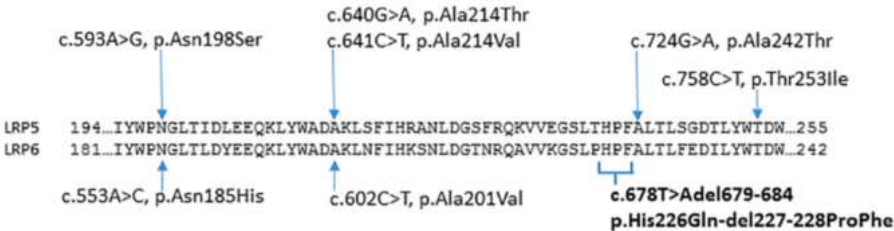
Comment:

DXA Results Summary:

| Region | Area (cm²) | BMC (g) | BMD (g/cm³) | T - score | PR (%) | Z - score | AM (%) |
|--------|------------|---------|-------------|-----------|--------|-----------|--------|
| L1     | 15.75      | 31.10   | 1.975       | 8.8       | 196    | 8.8       | 196    |
| L2     | 16.56      | 36.81   | 2.223       | 10.3      | 203    | 10.3      | 203    |
| L3     | 20.02      | 39.57   | 1.976       | 7.9       | 179    | 7.9       | 179    |
| L4     | 17.84      | 36.82   | 2.064       | 8.4       | 180    | 8.4       | 180    |
| L1-L4  | 70.17      | 144.31  | 2.057       | 8.8       | 189    | 8.2       | 190    |
| L2-L4  | 54.42      | 113.20  | 2.080       | 8.8       | 187    | 8.8       | 187    |

Total BMD CV: 1.0%, ACF = 1.042, BCF = 1.033, TH = 7.680  
WHO Classification: Normal  
Fracture Risk: Not Increased

B.



High bone mass from mutation of low-density lipoprotein receptor-related protein 6 (LRP6)<sup>☆,☆☆</sup>

María Lorena Brance<sup>a,b,c,\*</sup>, Lucas R. Brun<sup>b,c</sup>, Nicolás M. Cocco<sup>d</sup>, Andrés Aravena<sup>b</sup>, Shenghui Duan<sup>e</sup>, Steven Mumm<sup>e,f</sup>, Michael P. Whyte<sup>e,f</sup>

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<sup>b</sup> *Bone Biology Laboratory, School of Medicine, Rosario National University, Argentina*

<sup>c</sup> *National Council of Scientific and Technical Research (CONICET), Argentina*

<sup>d</sup> *Servicio de Diagnóstico por Imágenes, Sanatorio Británico, Rosario, Argentina*

<sup>e</sup> *Center for Metabolic Bone Disease and Molecular Research, Shriners Hospitals for Children, St. Louis, MO, USA*

<sup>f</sup> *Division of Bone and Mineral Diseases, Department of Internal Medicine, Washington University School of Medicine at Barnes-Jewish Hospital, St. Louis, MO, USA*



# Vertebral Fracture Assessment (VFA)

## Detección y valoración de fracturas vertebrales morfométricas

- AP y vista lateral de toda la columna vertebral
- Herramienta de evaluación visual o semicuantitativa de fracturas (Grado I 20-25%, Grado II 25-45%, Grado III >40%)
- También la visualización de la calcificación de la aorta abdominal (aprobado por la FDA).

**Hologic QDR Workstation**

Visual Tools: Analysta Tools

Assessment:

- ☐ Labeling Only
- ☐ Manual
- ☒ M/Apro

Display Options:

- ☒ Labels
- ☒ Display Markers
- ☒ Display Deformity
- ☒ Display M/Apro Outline

Refresh Image

Change Annotation:

T10

Normal

Delete

Reset

Print Report

Print Image

Close

For Help, press F1

**Name:** Sex: Female Height: 163.0 cm  
**Patient ID:** Ethnicity: White Weight: 55.6 kg  
**DOB:** 04.04.1986 Menopause Age: Age: 32

Referring Physician:

**Scan Information:**  
Scan Date: 03.07.2018 - A0703180N  
Scan Type: f SE R/L Lateral Image  
Analysis: 04 July 2018 14:21  
Operator:  
Model: Discovery Wi (93053M)  
Comment:

**Vertebral Assessment:**

| Label   | Height (mm)    |      |      | Percent Deformation |           |       |
|---------|----------------|------|------|---------------------|-----------|-------|
|         | Post           | Mid  | Ant  | Wedge               | Biconcave | Crush |
| T4      | 15.0<br>Normal | 15.5 | 15.6 | 0.0%                | -3.6%     | 3.8%  |
| T5      | 16.7<br>Normal | 15.5 | 15.3 | 8.1%                | 7.2%      | 0.0%  |
| T6      | 17.4<br>Normal | 16.7 | 15.4 | 11.7%               | 4.2%      | 0.0%  |
| T7      | 16.7<br>Normal | 16.8 | 15.1 | 9.8%                | -0.3%     | 0.0%  |
| T8      | 17.5<br>Normal | 16.7 | 18.4 | 0.0%                | 4.4%      | 4.8%  |
| T9      | 18.9<br>Normal | 16.7 | 18.1 | 4.4%                | 12.0%     | 0.0%  |
| T10     | 19.6<br>Normal | 18.1 | 18.8 | 3.7%                | 7.4%      | 0.0%  |
| T11     | 22.6<br>Normal | 20.6 | 20.4 | 10.0%               | 8.7%      | 0.0%  |
| T12     | 22.7<br>Normal | 21.4 | 22.1 | 2.8%                | 5.7%      | 0.0%  |
| L1      | 25.0<br>Normal | 23.6 | 24.6 | 1.6%                | 5.4%      | 0.0%  |
| L2      | 24.8<br>Normal | 24.1 | 25.7 | 0.0%                | 2.9%      | 3.6%  |
| L3      | 23.9<br>Normal | 24.6 | 26.1 | 0.0%                | -3.0%     | 8.4%  |
| L4      | 25.8<br>Normal | 24.2 | 25.3 | 2.1%                | 6.2%      | 0.0%  |
| Std Dev | 1.0            | 1.0  | 1.0  | 5.0%                | 5.0%      | 5.0%  |

**Physician's Comment:**

**HOLOGIC®**

3/07/2012 11:07

Shuhart CR, Yeap SS, Anderson PA, et al. Executive Summary of the 2019 ISCD Position. J Clin Densitom. 2019; 22:453-471  
Genant HK, et al. Vertebral fracture assessment using a semiquantitative technique. J Bone Miner Res. 1993; 8(9):1137-48.

# Antebrazo



- Centrado
- Derecho
- Radio y cubito distal visible
- No artefactos
- Radio y cubito alineado con el eje de la tabla



Radio 33% (1/3)  
para diagnóstico

|             |                   |                  |
|-------------|-------------------|------------------|
| Name:       | Sex: Female       | Height: 153.0 cm |
| Patient ID: | Ethnicity: White  | Weight: 75.3 kg  |
| DOB:        | Menopause Age: 50 | Age: 72          |

Referring Physician:

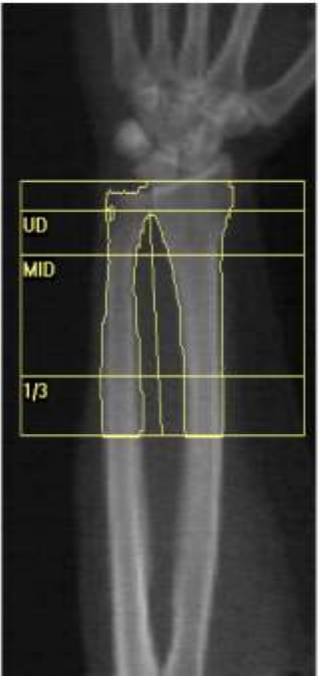


Image not for diagnostic use  
k = 1.232, d0 = 63.2  
228 x 87, Forearm Length: 23.0 cm

### Scan Information:

Scan Date: 15 August 2023 ID: A08152308  
Scan Type: a L-Forearm  
Analysis: 15 August 2023 10:19 Version 13.5.4:5  
Left Forearm  
Operator:  
Model: Discovery Wi (S/N 93053M)  
Comment:

### DXA Results Summary:

| Radius | Area (cm <sup>2</sup> ) | BMC (g) | BMD (g/cm <sup>2</sup> ) | T-score | PR (%) | Z-score | AM (%) |
|--------|-------------------------|---------|--------------------------|---------|--------|---------|--------|
| UD     | 3.41                    | 1.39    | 0.408                    | -0.6    | 92     | 1.0     | 117    |
| MID    | 5.85                    | 3.12    | 0.533                    | -1.4    | 88     | 0.9     | 110    |
| 1/3    | 2.77                    | 1.59    | 0.576                    | -2.0    | 83     | 0.3     | 103    |
| Total  | 12.03                   | 6.10    | 0.507                    | -1.3    | 88     | 0.8     | 110    |

Total BMD CV 1.0%, ACF = 1.042, BCF = 1.033

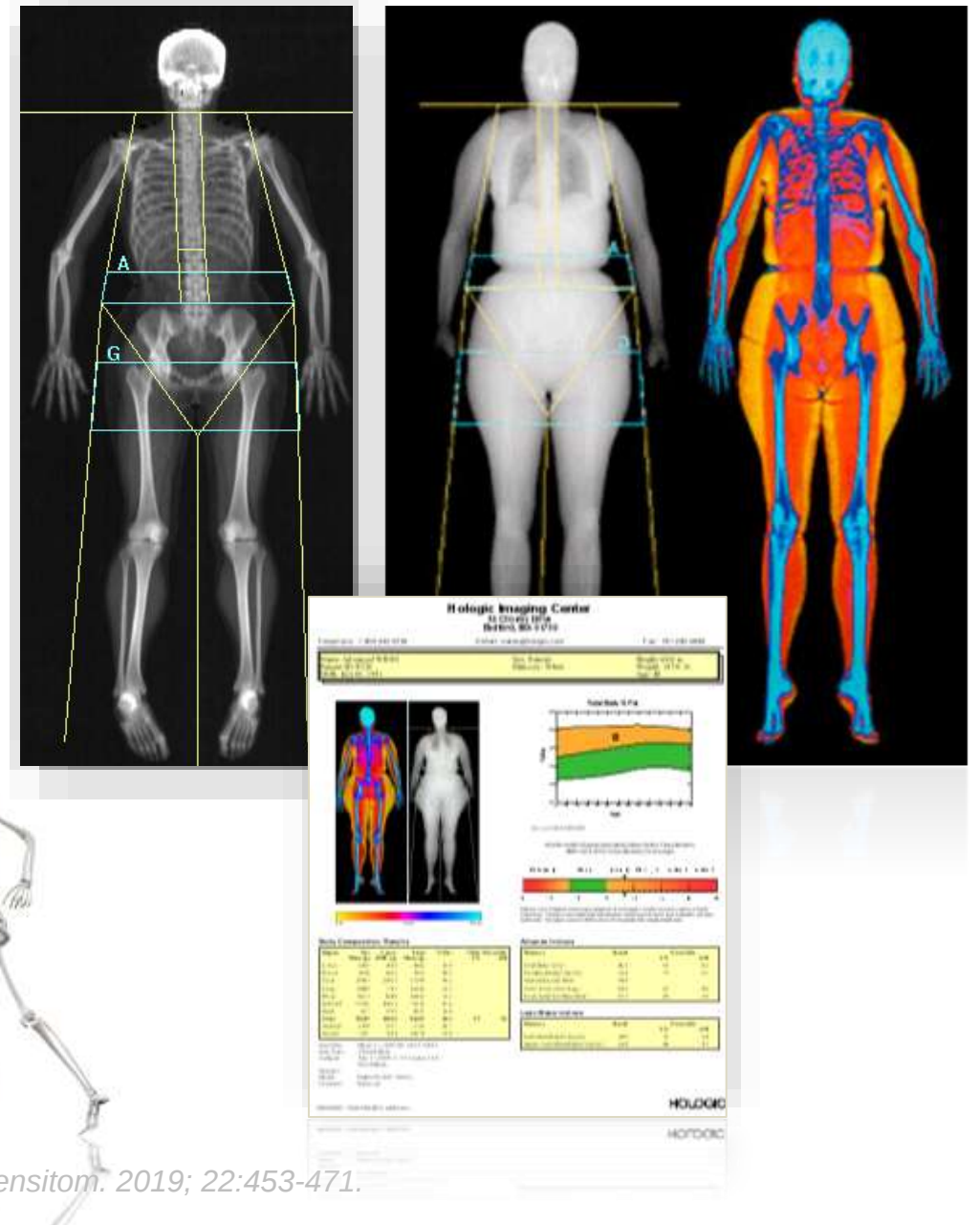
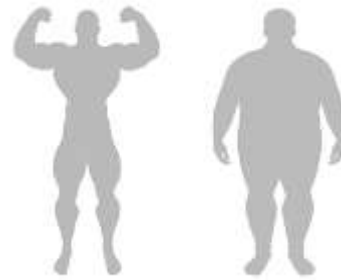
WHO Classification: Osteopenia  
Fracture Risk: Increased

# Composición Corporal

**Imágenes en color que muestran la distribución de la masa muscular, tejido graso y óseo total**

**La distribución individual de estos tejidos es de interés en diferentes condiciones clínicas:**

- Sarcopenia y Obesidad
- Monitoreo de la distribución de grasa y magra durante los cambios de peso
- Seguimiento del paciente en cirugía bariátrica
- Plan de entrenamiento deportivo



Shuhart CR, Yeap SS, Anderson PA, et al. Executive Summary of the 2019 ISCD Position. J Clin Densitom. 2019; 22:453-471.

# Research

**TABLE 2.** Whole-Body Composition, Lean, and Adipose Indices Assessments by DXA

|                                                           | CG               |                  |                  | RA Group                      |                               |                               |
|-----------------------------------------------------------|------------------|------------------|------------------|-------------------------------|-------------------------------|-------------------------------|
|                                                           | All (n = 100)    | Female (n = 84)  | Male (n = 16)    | All (n = 105)                 | Female (n = 87)               | Male (n = 18)                 |
| Body composition                                          |                  |                  |                  |                               |                               |                               |
| Total mass, kg                                            | 69.6 ± 12.1      | 67.9 ± 12.2      | 77.6 ± 7.9       | 70.0 ± 13.9                   | 67.8 ± 13.2                   | 82.0 ± 11.3                   |
| Total lean mass, <sup>b</sup> kg                          | 39.5 (36.2–44.5) | 38.5 (35.1–41.6) | 52.3 (50.3–55.2) | 37.6 (34.5–43.8)              | 36.1 (33.8–40.5) <sup>a</sup> | 52.7 (49.1–54.8)              |
| Lean mass, <sup>b</sup> %                                 | 57.8 (54.4–64.0) | 56.3 (53.9–61.5) | 67.3 (63.5–70.3) | 57.1 (52.4–61.4) <sup>a</sup> | 55.4 (51.6–58.5) <sup>a</sup> | 65.6 (60.3–68.0)              |
| ASM, <sup>b</sup> kg                                      | 16.6 (14.7–19.1) | 15.8 (14.4–17.3) | 22.9 (20.8–24.8) | 15.0 (13.4–18.0) <sup>a</sup> | 14.6 (13.2–16.8) <sup>a</sup> | 22.6 (20.6–24.0)              |
| Total fat mass, <sup>b</sup> kg                           | 25.4 (20.4–30.9) | 26.6 (21.9–31.6) | 21.2 (18.7–27.5) | 27.7 (22.9–32.6)              | 27.9 (23.0–32.9)              | 25.6 (21.5–29.3)              |
| Fat mass, <sup>b</sup> %                                  | 38.6 (32.9–42.9) | 40.8 (34.8–43.2) | 29.0 (25.5–33.2) | 40.2 (35.4–44.9) <sup>a</sup> | 41.9 (38.7–45.8) <sup>a</sup> | 31.5 (29.0–36.3) <sup>a</sup> |
| Lean indices                                              |                  |                  |                  |                               |                               |                               |
| Lean/height <sup>2</sup> , <sup>b</sup> kg/m <sup>2</sup> | 15.1 (14.1–16.6) | 14.9 (13.9–16.0) | 17.3 (16.7–18.0) | 15.1 (13.7–16.7)              | 14.8 (13.4–15.9)              | 17.3 (16.8–18.3)              |
| ASM/height <sup>2</sup> , <sup>b</sup> kg/m <sup>2</sup>  | 6.3 (5.8–7.0)    | 6.1 (5.6–6.6)    | 7.4 (7.1–8.1)    | 6.1 (5.4–7.0)                 | 5.9 (5.3–6.5)                 | 7.4 (7.0–8.1)                 |
| Adipose indices                                           |                  |                  |                  |                               |                               |                               |
| Fat mass/height <sup>2</sup> , kg/m <sup>2</sup>          | 10.01 ± 3.36     | 10.56 ± 3.39     | 7.50 ± 1.77      | 11.17 ± 3.52 <sup>a</sup>     | 11.56 ± 3.51 <sup>a</sup>     | 9.08 ± 2.80 <sup>a</sup>      |
| Android/gynoid ratio <sup>b</sup>                         | 0.94 (0.80–1.05) | 0.91 (0.77–1.01) | 1.08 (1.04–1.18) | 1.00 (0.89–1.10) <sup>a</sup> | 0.98 (0.84–1.06) <sup>a</sup> | 1.15 (1.06–1.24) <sup>a</sup> |
| Waist circumference, cm                                   | —                | 85.9 ± 14.1      | 91.5 ± 7.3       | —                             | 91.3 ± 13.4 <sup>a</sup>      | 101.1 ± 10.5 <sup>a</sup>     |
| Est. VAT mass, g                                          | 566.2 ± 305.8    | 564.5 ± 325.1    | 573.9 ± 200.6    | 692.7 ± 350.0 <sup>a</sup>    | 658.6 ± 345.5 <sup>a</sup>    | 871.6 ± 327.7 <sup>a</sup>    |

<sup>a</sup>Significant differences versus its respective CG. <sup>b</sup>Nonparametric variables (without normal distribution or unequal variances). ASM, appendicular skeletal muscle mass; Est. VAT, estimated visceral adipose tissue.

Mean±SD or Median (IQR).

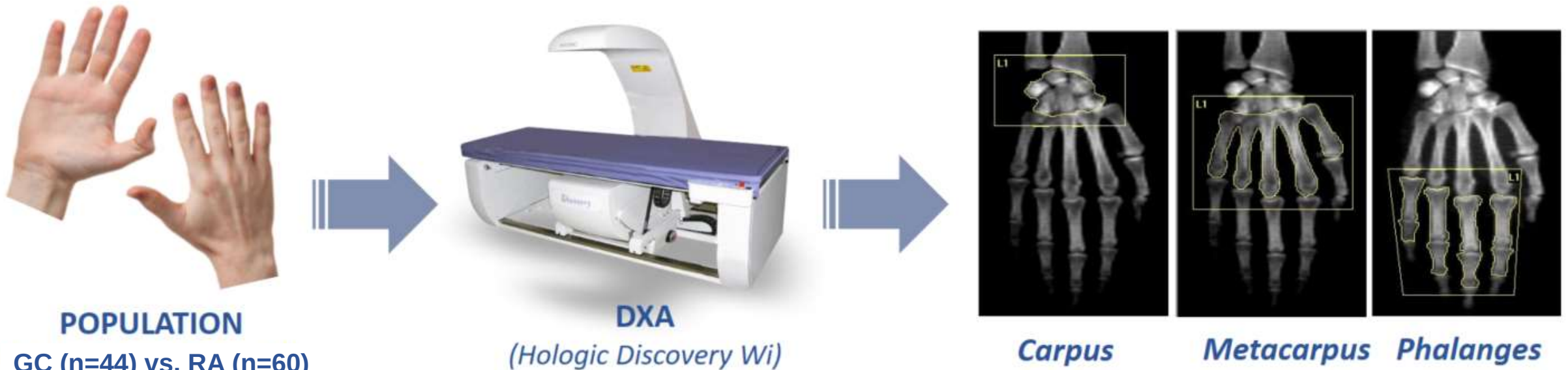
\* Mayor prevalencia de sarcopenia, obesidad sarcopénica y un menor porcentaje de masa magra en mujeres con AR.

\*Se observó sarcopenia en mujeres con AR más jóvenes en comparación con sujetos control sanos.

\* La sarcopenia se asoció con fracturas por fragilidad previas en mujeres con AR.

Brance ML, et al. Prevalence of Sarcopenia and Whole-Body Composition in Rheumatoid Arthritis. *J Clin Rheumatol.* 2021;27(6S):S153-S160.

# Research



Brance ML, et al. Whole-hand and regional bone mineral density involvement in rheumatoid arthritis. *Reumatol Clin (Engl Ed)*. 2023;19(10):555-9.

# Research

**Table 2**

Differences in the lumbar spine and hands BMD between RA patients and control subjects.

| BMD (g/cm <sup>2</sup> )     | Control (n = 44)           | RA (n = 60)    | %     | p       |
|------------------------------|----------------------------|----------------|-------|---------|
| <i>Lumbar spine BMD</i>      | 1.014 ± 0.122              | 0.926 ± 0.140* | −8.7  | 0.0032  |
| <i>Dominant hand BMD</i>     |                            |                |       |         |
| Total hand                   | 0.296 ± 0.030              | 0.268 ± 0.036* | −9.5  | 0.0003  |
| Carpus                       | 0.423 ± 0.061              | 0.391 ± 0.059* | −7.6  | 0.0113  |
| Metacarpal bones             | 0.293 ± 0.029              | 0.261 ± 0.039* | −10.9 | <0.0001 |
| Phalanges                    | 0.242 ± 0.030              | 0.223 ± 0.036* | −7.8  | 0.0114  |
| <i>Non-dominant hand BMD</i> |                            |                |       |         |
| Total hand                   | 0.286 ± 0.026 <sup>#</sup> | 0.261 ± 0.036* | −8.7  | 0.0005  |
| Carpus                       | 0.394 ± 0.038 <sup>#</sup> | 0.382 ± 0.073  | −3.0  | ns      |
| Metacarpal bones             | 0.285 ± 0.028 <sup>#</sup> | 0.252 ± 0.034* | −11.6 | <0.0001 |
| Phalanges                    | 0.239 ± 0.028              | 0.219 ± 0.036* | −8.4  | 0.0059  |

\* Indicates significant differences versus controls ( $p < 0.05$ ).

<sup>#</sup> Indicates significant differences versus the dominant hand ( $p < 0.05$ ).

La DMO de la mano fue significativamente menor en pacientes con AR vs GC, y se observó una correlación significativa con la DMO de CL.

Además, la DMO de toda la mano, los metacarpianos y el carpo fue significativamente mayor en la mano dominante en comparación con la mano no dominante, sin diferencias en las falanges ROI.

# Research

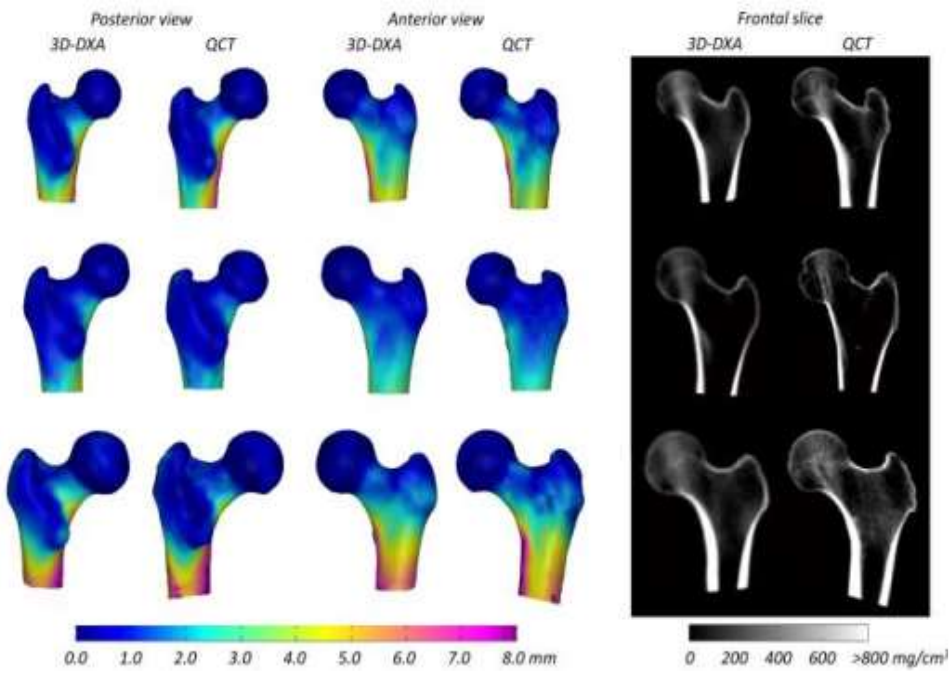
| n=802                         | Dominant | Non-dominant | Side mean difference<br>(95% CI) | Side % difference<br>(95% CI) | p- value |
|-------------------------------|----------|--------------|----------------------------------|-------------------------------|----------|
| <b>Women (n=458)</b>          |          |              |                                  |                               |          |
| <b>Upper limbs</b>            |          |              |                                  |                               |          |
| <b>BMD (g/cm<sup>2</sup>)</b> | 0.646    | 0.622        | 0.023 (0.021-0.026)              | 3.99 (3.66/4.32)              | <0.0001  |
| <b>BMC (g)</b>                | 135.5    | 128.3        | 7.2 (6.5-7.8)                    | 5.94 (5.42/6.46)              | <0.0001  |
| <b>LM (g)</b>                 | 1826.5   | 1781.2       | 45.2 (34.5-55.9)                 | 2.72 (2.12/3.32)              | <0.0001  |
| <b>Lower limbs</b>            |          |              |                                  |                               |          |
| <b>BMD (g/cm<sup>2</sup>)</b> | 1.058    | 1.051        | 0.007 (0.002-0.12)               | 0.72 (0.28/1.16)              | 0.002    |
| <b>BMC (g)</b>                | 366.8    | 363.8        | 2.9 (1.8-4.1)                    | 0.91 (0.58/1.24)              | <0.0001  |
| <b>LM (g)</b>                 | 6005.4   | 5968.5       | 36.9 (14.5-59.4)                 | 0.68 (0.29/1.07)              | 0.001    |
| <b>Men (n=344)</b>            |          |              |                                  |                               |          |
| <b>Upper limbs</b>            |          |              |                                  |                               |          |
| <b>BMD (g/cm<sup>2</sup>)</b> | 0.804    | 0.776        | 0.028 (0.26/0.031)               | 3.74 (3.39/4.08)              | <0.0001  |
| <b>BMC (g)</b>                | 215.1    | 204.7        | 10.3 (9.3/11.4)                  | 5.11 (4.59/5.62)              | <0.0001  |
| <b>LM (g)</b>                 | 3237.7   | 3111.6       | 126.1 (108.2/144.0)              | 4.17 (3.59/4.75)              | <0.0001  |
| <b>Lower limbs</b>            |          |              |                                  |                               |          |
| <b>BMD (g/cm<sup>2</sup>)</b> | 1.302    | 1.299        | 0.003 (-0.001/0.007)             | 0.29 (-0.03/0.60)             | ns       |
| <b>BMC (g)</b>                | 548.4    | 548.2        | 0.22 (-1.4-1.8)                  | 0.04 (-0.24/0.33)             | ns       |
| <b>LM (g)</b>                 | 9022.6   | 8912.9       | 109.7 (78.8-140.5)               | 1.29 (0.94/1.63)              | <0.0001  |

Nuestros hallazgos sugieren que la dominancia lateral tiene un impacto diferencial en la composición corporal según el sexo.

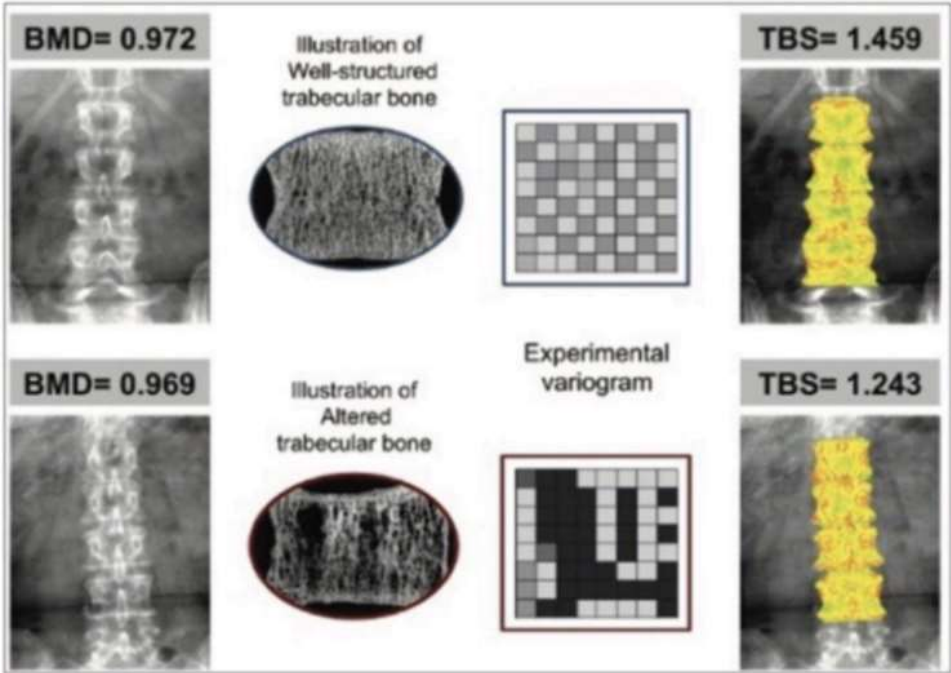
Este estudio destaca la importancia de considerar las asimetrías laterales en la composición corporal al evaluar intervenciones terapéuticas y diagnósticas en medicina clínica e investigación ósea.

Brance ML, et al. Side-to-side differences in bone mineral density, bone mineral content and lean mass in healthy subjects. **Submitted 2025**

# Potenciales usos (requiere software adicional)



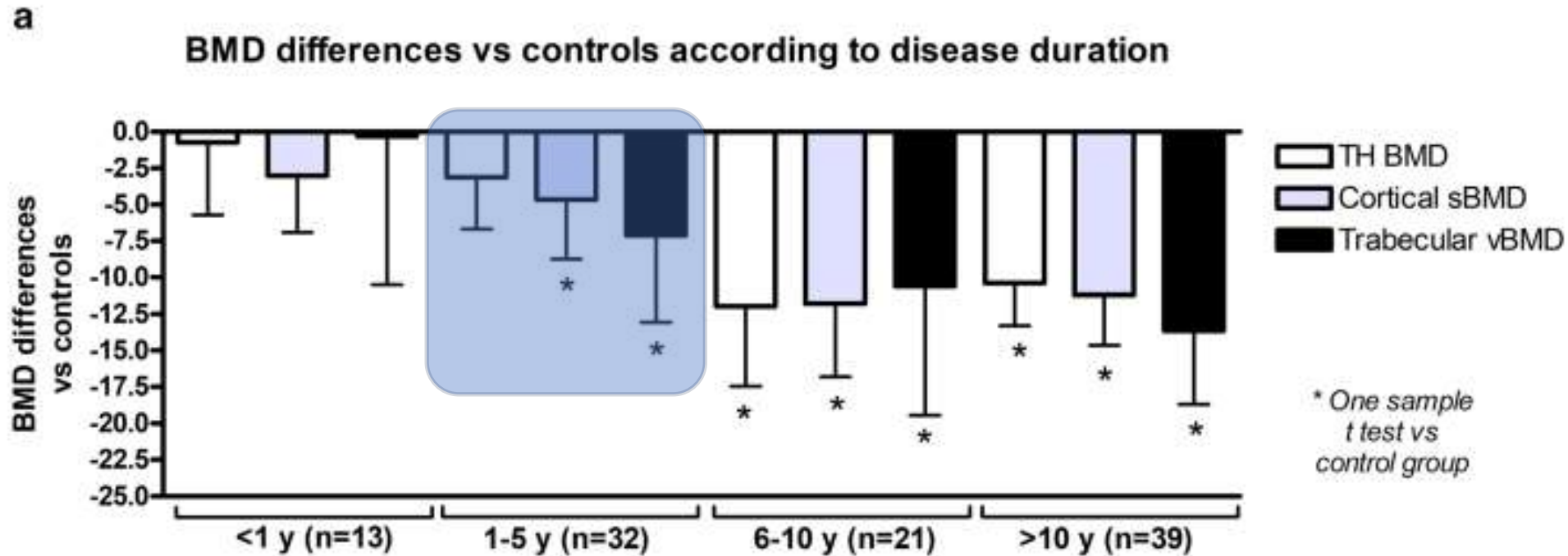
3D-DXA



TBS



## DMO total de la cadera y parámetros trabeculares y corticales 3D según la duración de la enfermedad

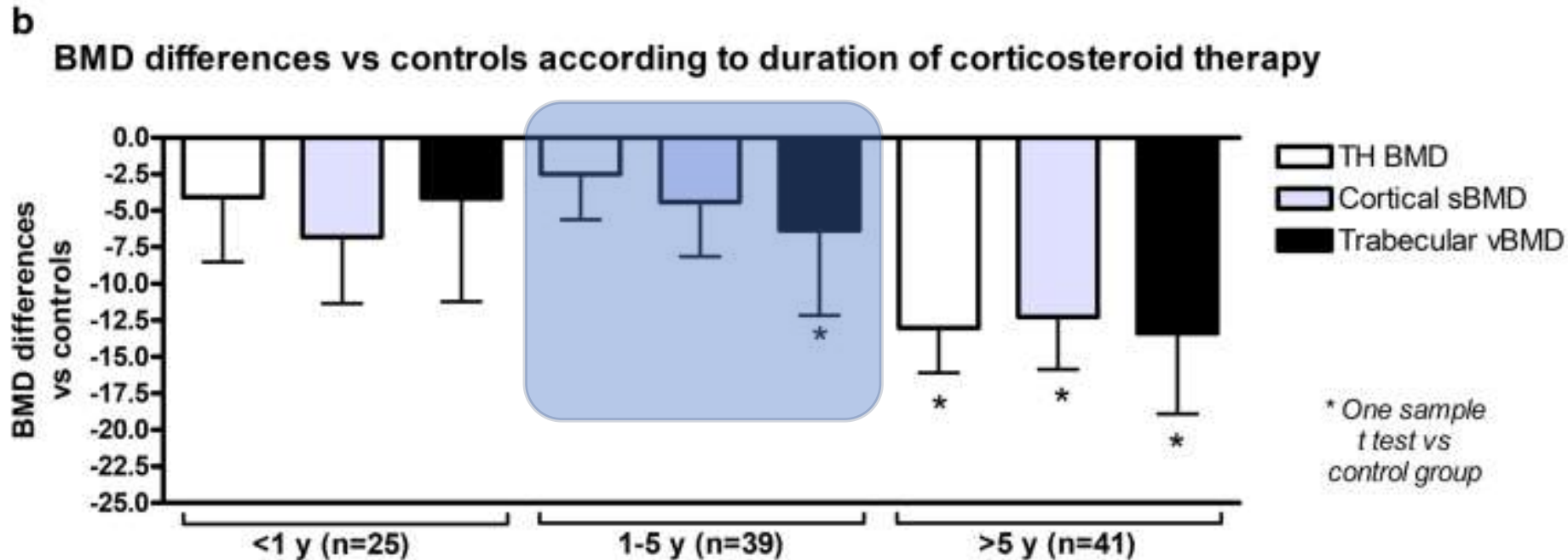


Brance ML, et al. Trabecular and cortical bone involvement in rheumatoid arthritis by DXA and DXA-based 3D modelling. *Osteoporos Int.* 2021

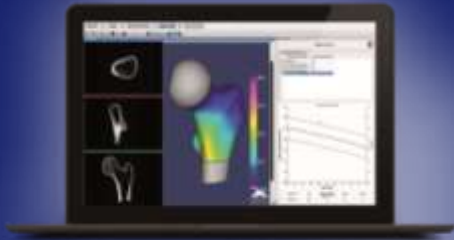
# Research



## DMO total de la cadera y parámetros trabeculares y corticales 3D según la duración del tratamiento con glucocorticoides.



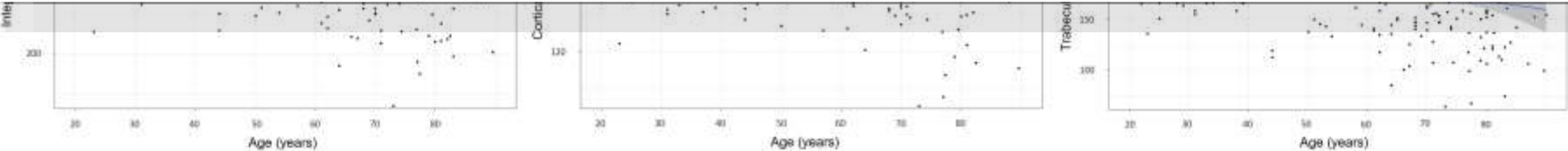
Brance ML, et al. Trabecular and cortical bone involvement in rheumatoid arthritis by DXA and DXA-based 3D modelling. *Osteoporos Int.* 2021



**Table 3.** Age- and sex-related volumetric density differences in trabecular and cortical bone of the proximal femur in healthy subjects from Argentina using 3-dimensional dual energy X-ray absorptiometry

|                                       | Mean ± standard deviation (20–29 yr) | % Change (20–90 yr) | Absolute change (20–90 yr) | Age sloped ( <i>P</i> -value) |                  |
|---------------------------------------|--------------------------------------|---------------------|----------------------------|-------------------------------|------------------|
|                                       |                                      |                     |                            | PreM                          | PostM            |
| Women (N = 1,001)                     |                                      |                     |                            |                               |                  |
| Integral vBMD (mg/cm <sup>3</sup> )   | 373.5 ± 48.1                         | -23.1 <sup>bi</sup> | -87.4 ± 83.2 <sup>bi</sup> | -0.662 (0.07)                 | -1.548 (0.00001) |
| Trabecular vBMD (mg/cm <sup>3</sup> ) | 223.3 ± 39.3                         | -33.4 <sup>bi</sup> | -75.1 ± 58.6 <sup>bi</sup> | -0.916 (0.003)                | -1.121 (0.0001)  |
| Cortical sBMD (mg/cm <sup>2</sup> )   | 166.5 ± 23.8                         | -9.9 <sup>bi</sup>  | -17.2 ± 38.1 <sup>bi</sup> | 0.02 (NS)                     | -0.328 (0.0003)  |
| Men (N = 353)                         |                                      |                     |                            |                               |                  |
| Integral vBMD (mg/cm <sup>3</sup> )   | 371.2 ± 53.2                         | -16.6 <sup>bi</sup> | -61.5 ± 81.1 <sup>bi</sup> |                               |                  |
| Trabecular vBMD (mg/cm <sup>3</sup> ) | 232.8 ± 46.2                         | -27.7 <sup>bi</sup> | -64.1 ± 65.4 <sup>bi</sup> |                               |                  |
| Cortical sBMD (mg/cm <sup>2</sup> )   | 178.5 ± 21.5                         | -4.4 <sup>ci</sup>  | -8.3 ± 33.2 <sup>ci</sup>  |                               |                  |

<sup>a)</sup>*P*<0.05, <sup>b)</sup>*P*<0.001, <sup>c)</sup>not significant.  
PreM, premenopausal; PostM, postmenopausal; vBMD, volumetric bone mineral density; Cortical sBMD, cortical surface bone mineral density.



Age- and Sex-Related Volumetric Density Differences in Trabecular and Cortical Bone of the Proximal Femur in Healthy Population



INVESTIGACIÓN, DOCENCIA Y ASISTENCIA  
ASOCIACIÓN ARGENTINA DE  
OSTEOLOGÍA Y METABOLISMO MINERAL

Brance ML, et al. J Bone Metab. 2024; 31(4):279-289.

# Conclusiones

*Destacar la problemática actual de las fracturas por fragilidad en la morbimortalidad de una población con mayor expectativa de vida.*

*Enfatizar en la relevancia de la DXA como estudio fundamental tanto para diagnóstico como para seguimiento.*

*Recalcar la importancia del posicionamiento y adquisición.*

*Acentuar el rol del profesional que realiza el informe y de quien lo recibe.*

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**XXXII**

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**Table 3.** Age- and sex-related volumetric density differences in trabecular and cortical bone of the proximal femur in healthy subjects from Argentina using 3-dimensional dual energy X-ray absorptiometry

|                                       | Mean ± standard deviation (20–29 yr) | % Change (20–90 yr) | Absolute change (20–90 yr) | Age sloped ( <i>P</i> -value) |                  |
|---------------------------------------|--------------------------------------|---------------------|----------------------------|-------------------------------|------------------|
|                                       |                                      |                     |                            | PreM                          | PostM            |
| Women (N=1,001)                       |                                      |                     |                            |                               |                  |
| Integral vBMD (mg/cm <sup>3</sup> )   | 373.5 ± 48.1                         | -23.1 <sup>b)</sup> | -87.4 ± 83.2 <sup>b)</sup> | -0.662 (0.07)                 | -1.548 (0.00001) |
| Trabecular vBMD (mg/cm <sup>3</sup> ) | 223.3 ± 39.3                         | -33.4 <sup>b)</sup> | -75.1 ± 58.6 <sup>b)</sup> | -0.916 (0.003)                | -1.121 (0.0001)  |
| Cortical sBMD (mg/cm <sup>2</sup> )   | 166.5 ± 23.8                         | -9.9 <sup>b)</sup>  | -17.2 ± 38.1 <sup>b)</sup> | 0.02 (NS)                     | -0.328 (0.0003)  |
| Men (N=353)                           |                                      |                     |                            |                               |                  |
| Integral vBMD (mg/cm <sup>3</sup> )   | 371.2 ± 53.2                         | -16.6 <sup>b)</sup> | -61.5 ± 81.1 <sup>b)</sup> |                               |                  |
| Trabecular vBMD (mg/cm <sup>3</sup> ) | 232.8 ± 46.2                         | -27.7 <sup>b)</sup> | -64.1 ± 65.4 <sup>b)</sup> |                               |                  |
| Cortical sBMD (mg/cm <sup>2</sup> )   | 178.5 ± 21.5                         | -4.4 <sup>c)</sup>  | -8.3 ± 33.2 <sup>c)</sup>  |                               |                  |

<sup>a)</sup>*P*<0.05, <sup>b)</sup>*P*<0.001, <sup>c)</sup>not significant.  
PreM, premenopausal; PostM, postmenopausal; vBMD, volumetric bone mineral density; Cortical sBM

