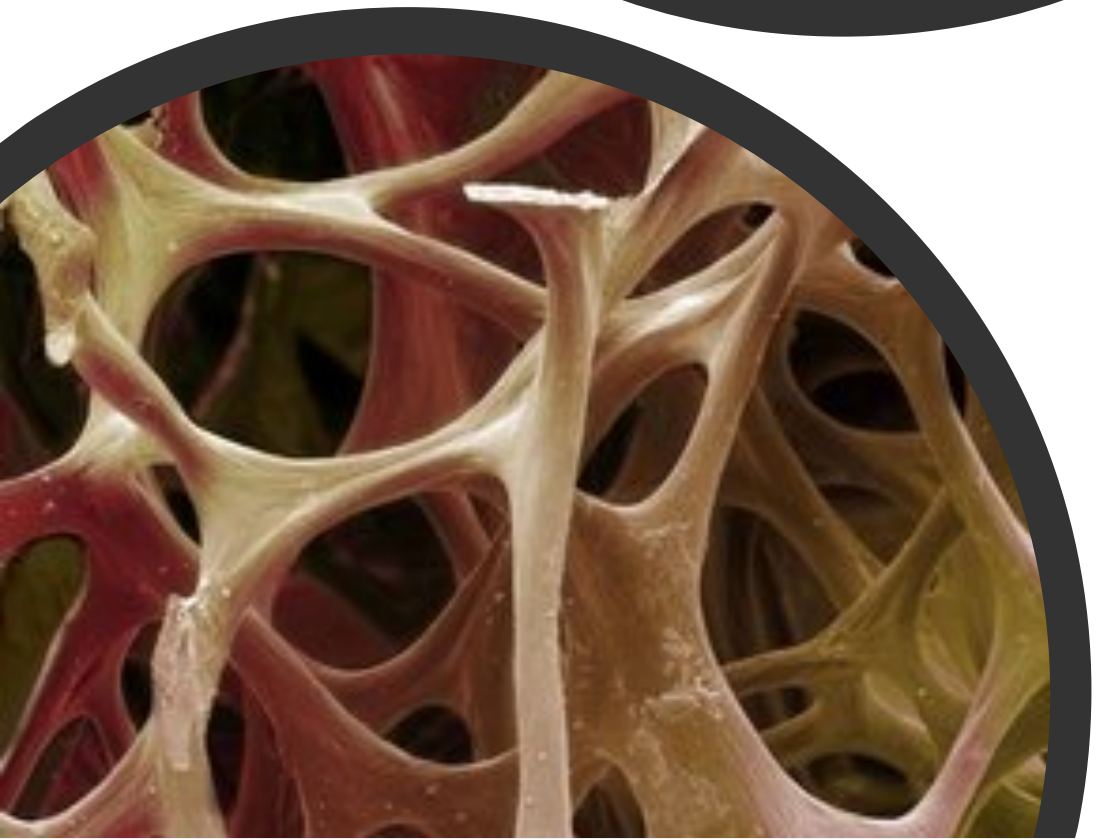


Bone Health 101

Nick Birch

Consultant Spinal Specialist

OsteoscanUK Webinar

25 January 2021

Healthy bone: ***What is it and why is it important?***

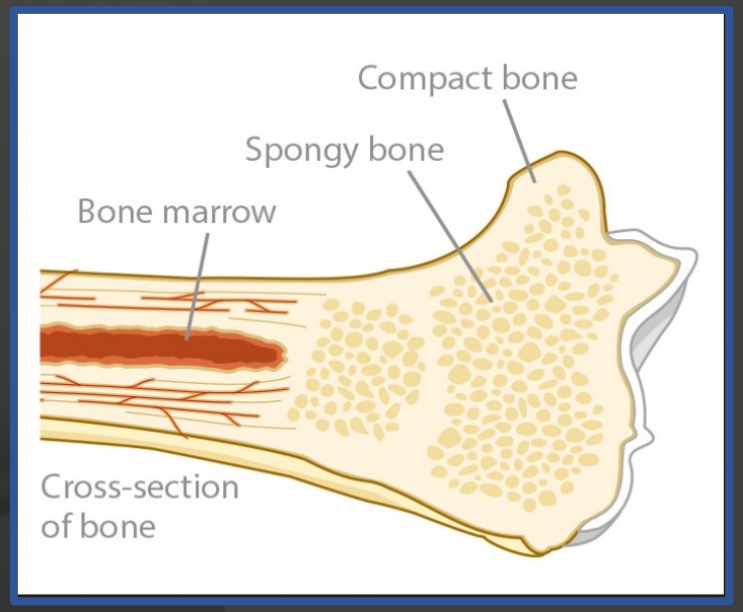
Bone health: ***The influence of diet and exercise***

Bone health: ***How is it measured?***

Impaired bone health: ***Treatment options***

Bone

The Skeleton: 206 Bones



Compact "cortical" bone (80%)

Toughest outer layer of bone that provides strength allowing us to move and be active

Spongy "cancellous" bone (15% - 18%)

Looks like honeycomb and it fills the space inside the compact bone. It contains the

Bone marrow (2% - 5%) where blood cells are made

Bone Constituents

Bones are made of connective tissue *Collagen* reinforced with *Calcium* and *Specialised bone cells – Osteocytes, Osteoblasts, Osteoclasts (control, build, consume)*

Most bones also contain some bone marrow

More than *99 percent of the body's Calcium is contained in the bones and teeth*

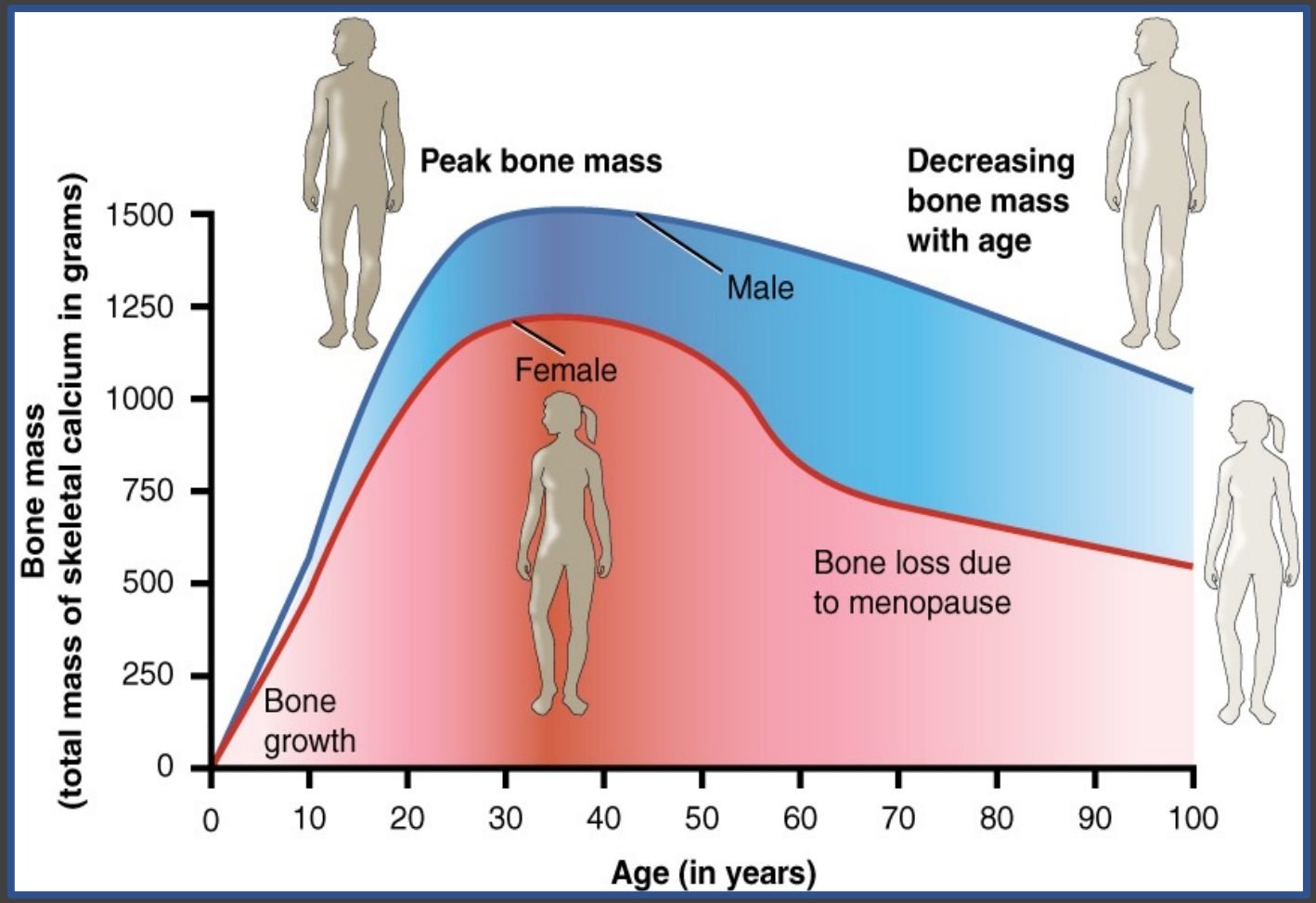
The remaining *1 percent is found in the blood*

Bone and Age

A *new-born has no calcium in the skeleton* just cartilage

From birth to 30 years old we *make more bone than we lose*

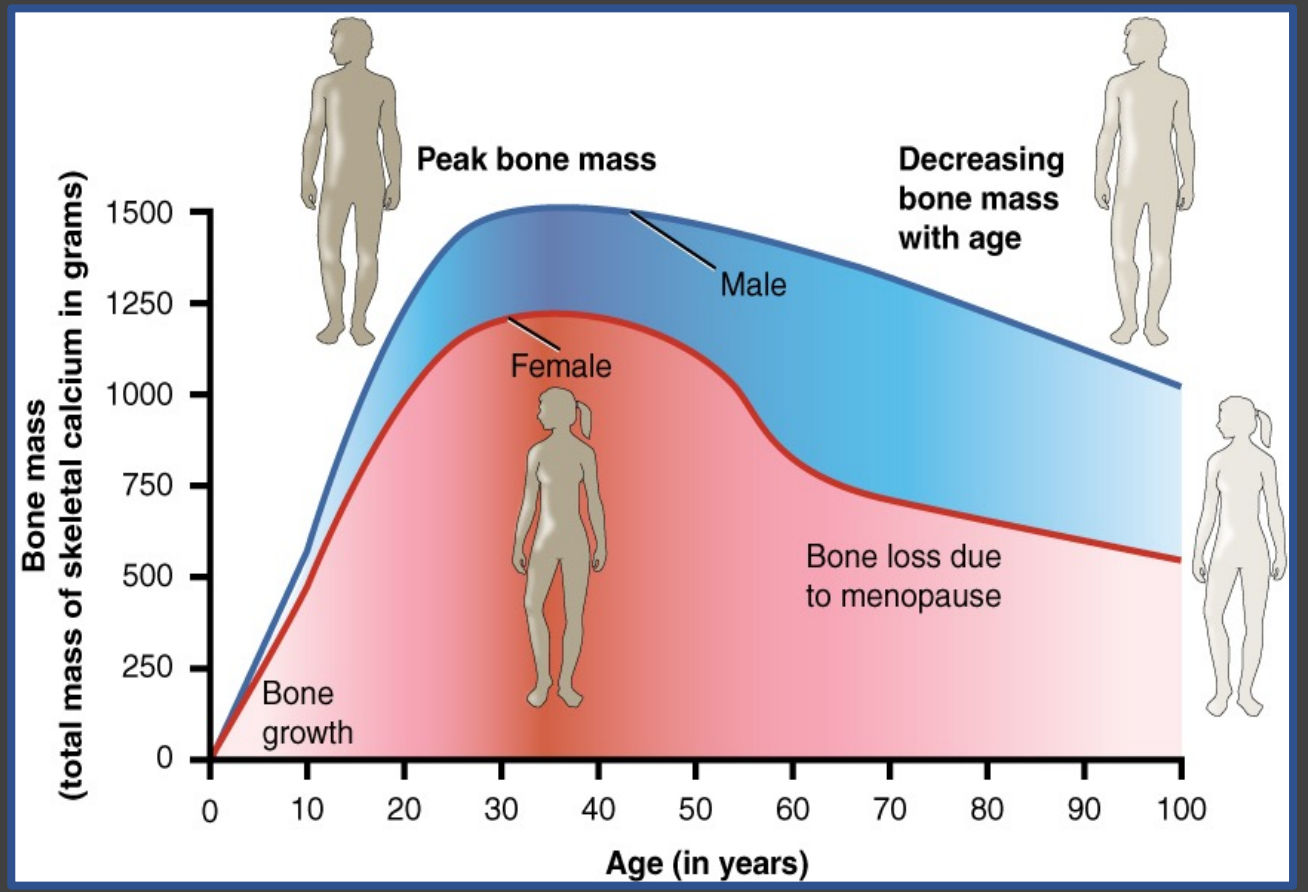
At 30, *Peak Bone Mass* is reached



From 30 to 40 *the rate we make bone is equal to the rate you lose it* and bone density remains fairly static

From 40 to 50 years *the rate we lose bone starts to increase*

Over 50 years for women bone loss accelerates for about a decade and *bone density continues to decline thereafter*



The Bone Bank

Diet and activity levels up to the age of 30 are vital for later bone health *adding to the Bone Bank*

After age 20, bone *"withdrawals" can begin to exceed "deposits"*

For many people, *bone loss can be prevented with correct dietary calcium and vitamin D, regular exercise and avoiding tobacco and excessive alcohol intake*

The Bone Bank

Osteoporosis develops when *bone removal occurs too quickly, replacement occurs too slowly*, or both

Not reaching maximum peak bone mass during your bone-building years means *osteoporosis is more likely later in life*

Keeping Bone Healthy

After Peak Bone Mass and the plateau for the next 10 years, bone loss starts

But…plenty can be done to *slow the decline*

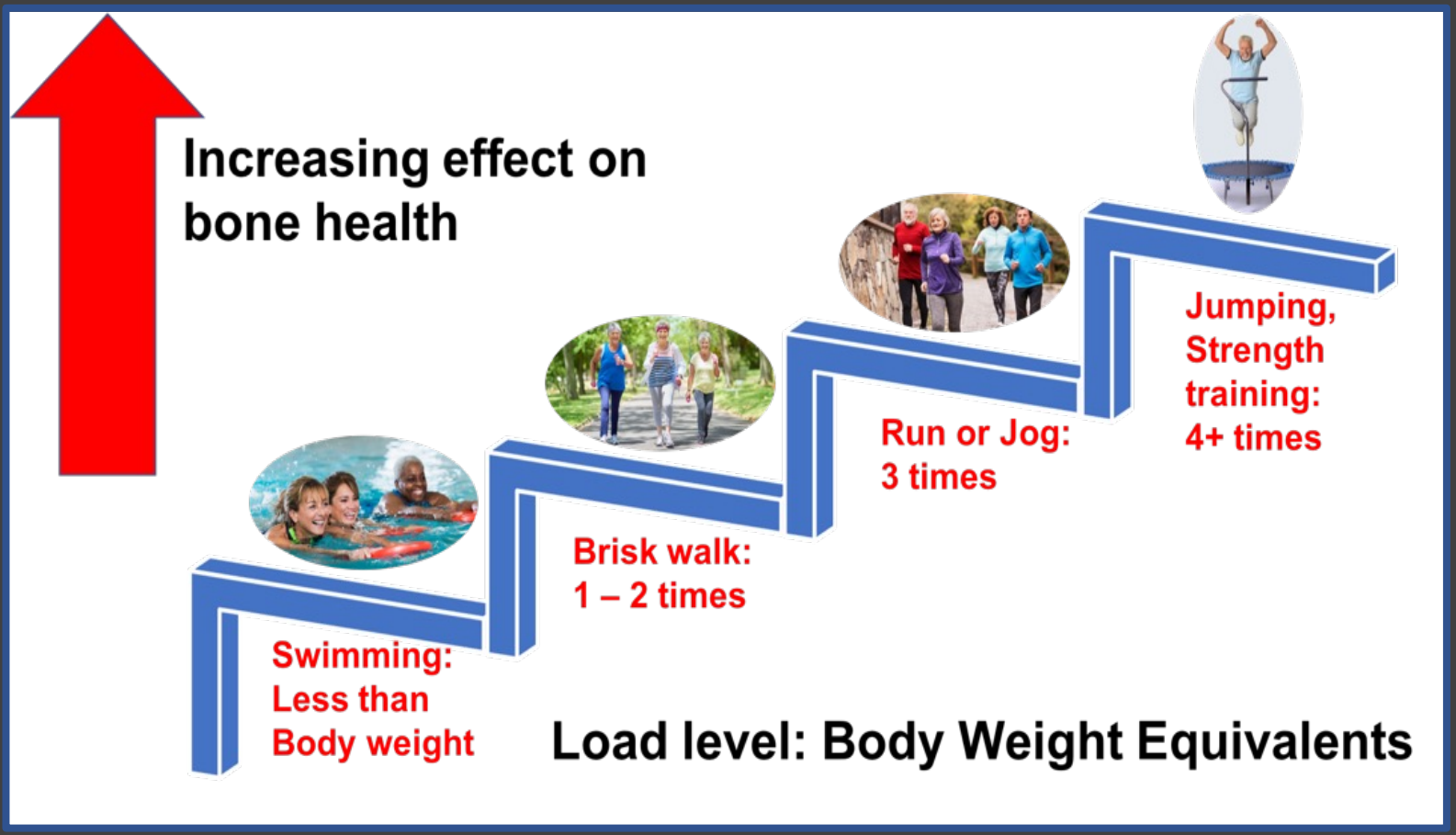
Good dietary and exercise habits help to keep bones healthy

Stay Stronger for Longer

Key Nutrients for Bone Health

		Food sources
Calcium	1000 – 1200 mg / day	Dairy, nuts, fruit, vegetables, rice, pulses, sardines etc,
Vitamin D3	1000 iu – 6000 iu / day	Oily fish, liver, eggs, meat, milk, margarine, fruit juice, cereals (fortified)
Magnesium	420 mg /day	Green leafy veg, nuts, seeds, grains (foods with fibre)
Vitamin K2	90 -120 micrograms / day	Dairy (cream), Fermented foods (inc cheese), meat, egg yolk
Boron	5 - 7 mg /day	Milk, apples, beans, potatoes

Exercise for Bone Health



Seniors Can Still Bulk Up On Muscle By Pressing Iron

LISTEN · 4:24 QUEUE Download Transcript

February 21, 2011 · 12:01 AM ET
Heard on Morning Edition

PATTI NEIGHMOND

Sandy Palais, 73, of Arizona started lifting weights about 10 years ago after she was diagnosed with osteoporosis.
Jason Millstein for NPR

A 77-year-old former nun has set a record for powerlifting — now she wants to beat it

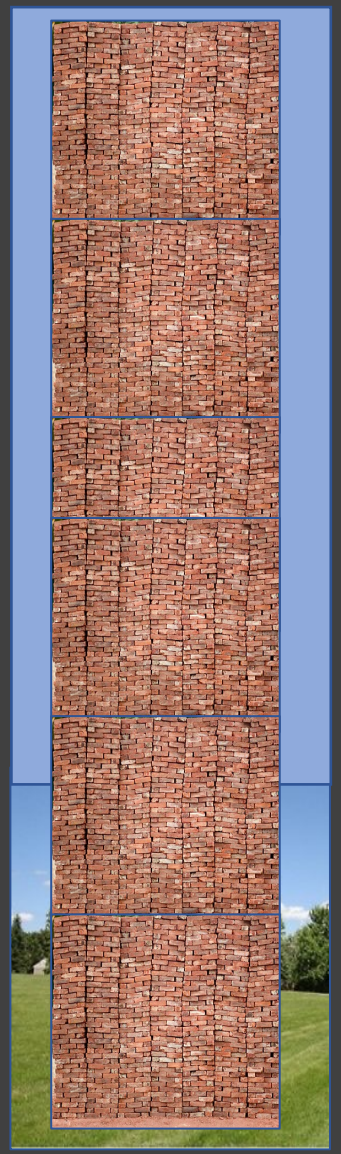
By Marilisa Racco National Online Journalist, Smart Living Global News

Marion Keane has set a new goal for herself: the 77-year-old will aim to lift 220 pounds at a competition later this year.

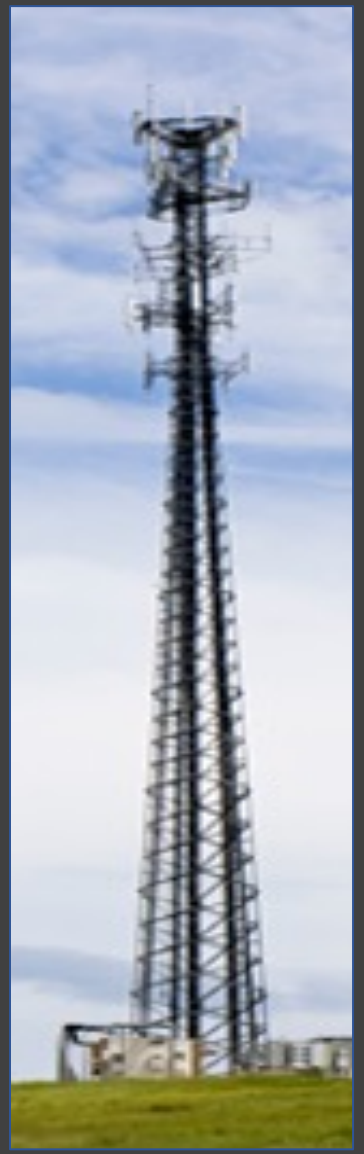
Healthy Bone

Mineral content

Massive
No structural integrity



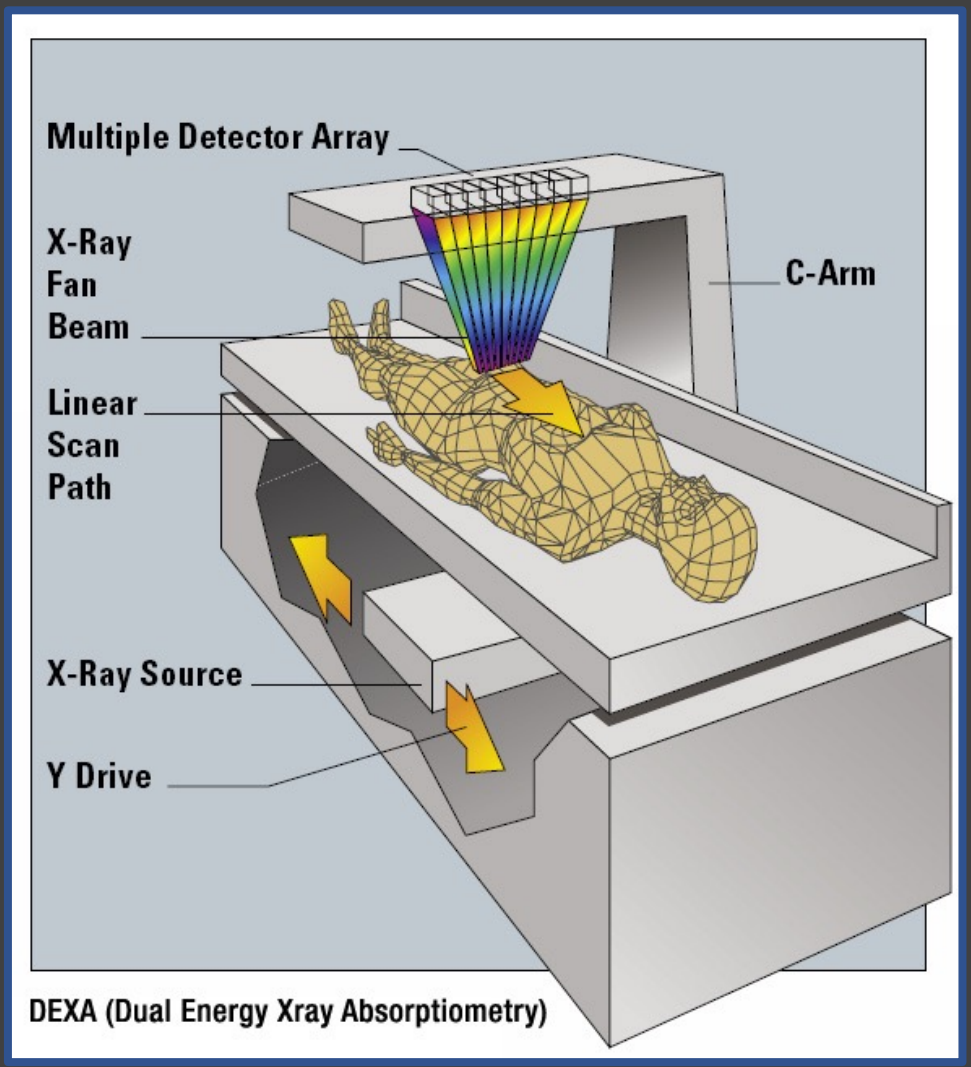
Toughness



Light-weight
Well-built

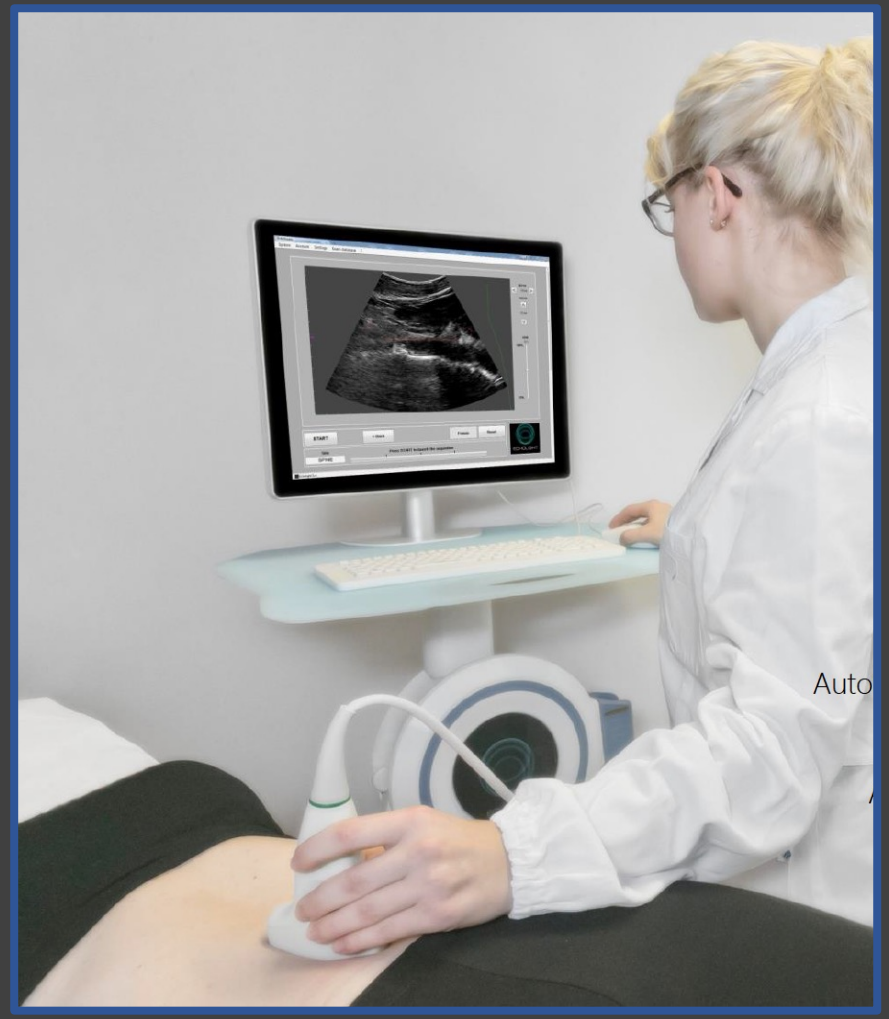
Measuring Bone Health

DEXA: Dual Energy X-ray Absorptiometry



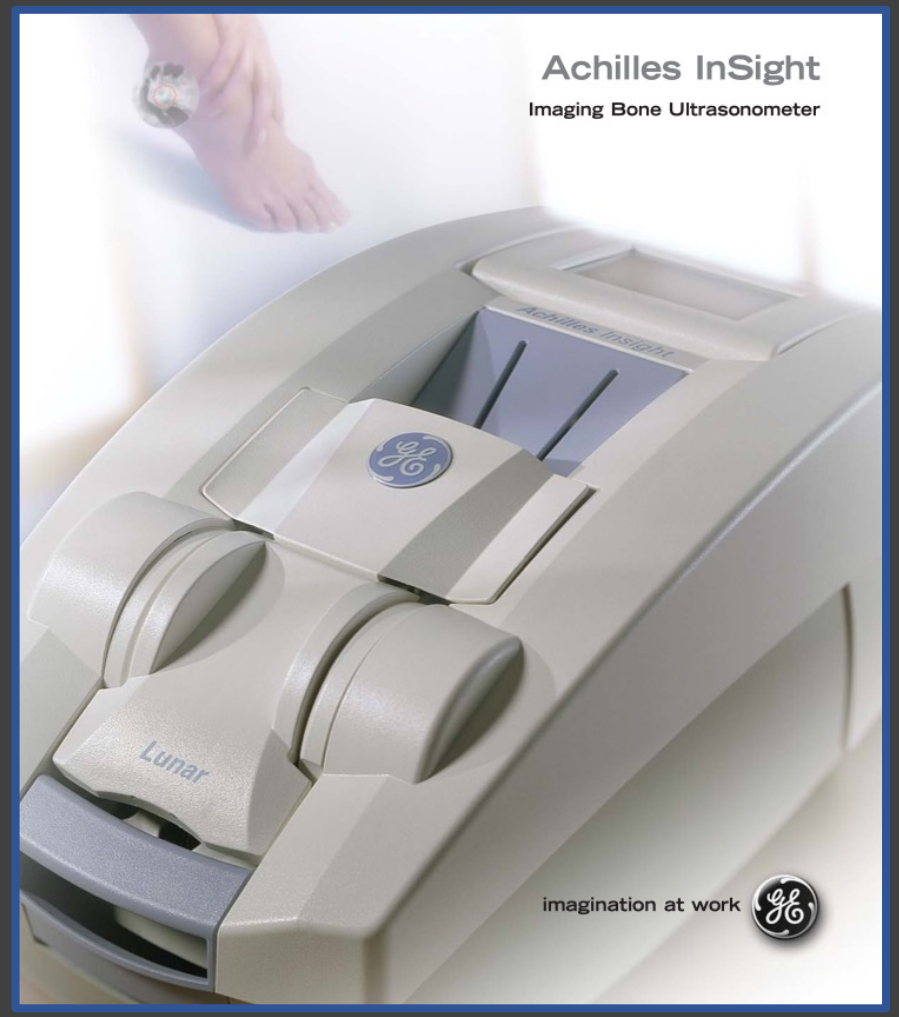
DEXA (Dual Energy Xray Absorptiometry)

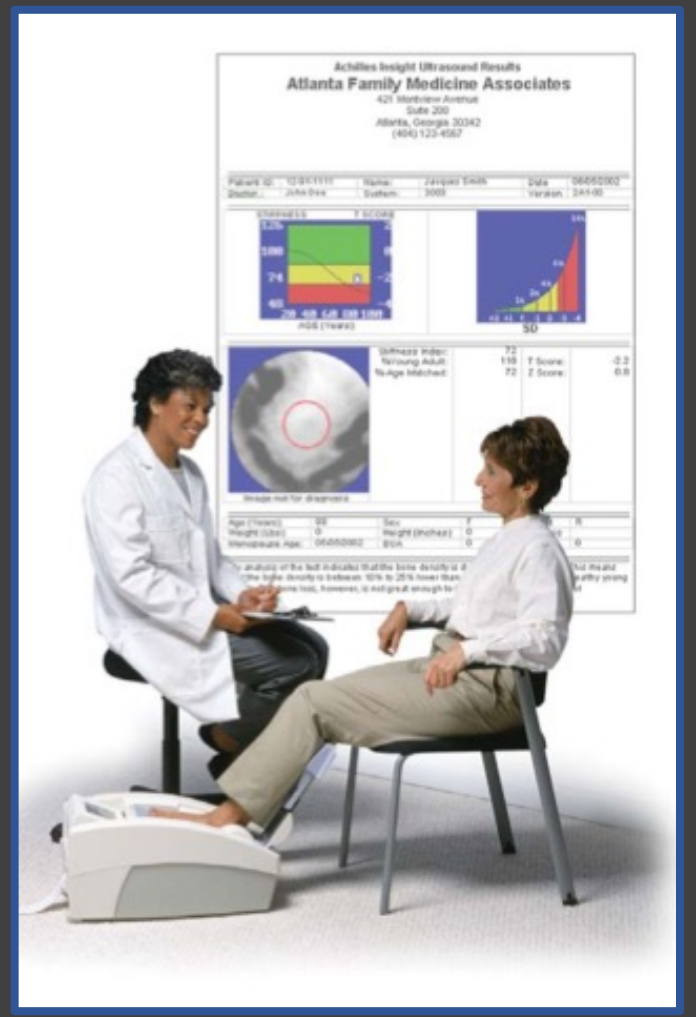
REMS Scan
(Radiofrequency Echographic Multispectrometry)



QpCT
Quantitative Peripheral CT

QUS
Quantitative Ultrasound





Bone Health Measurement Devices

		Bone Toughness		
Technology	BMD (bone mineral density)	Trabecular Bone Score	Fragility Index	Bone stiffness
DEXA	+	+ (if sw loaded)	-	-
REMS	+	-	+	-
QpCT	+	-	-	-
QUS	+	-	-	+

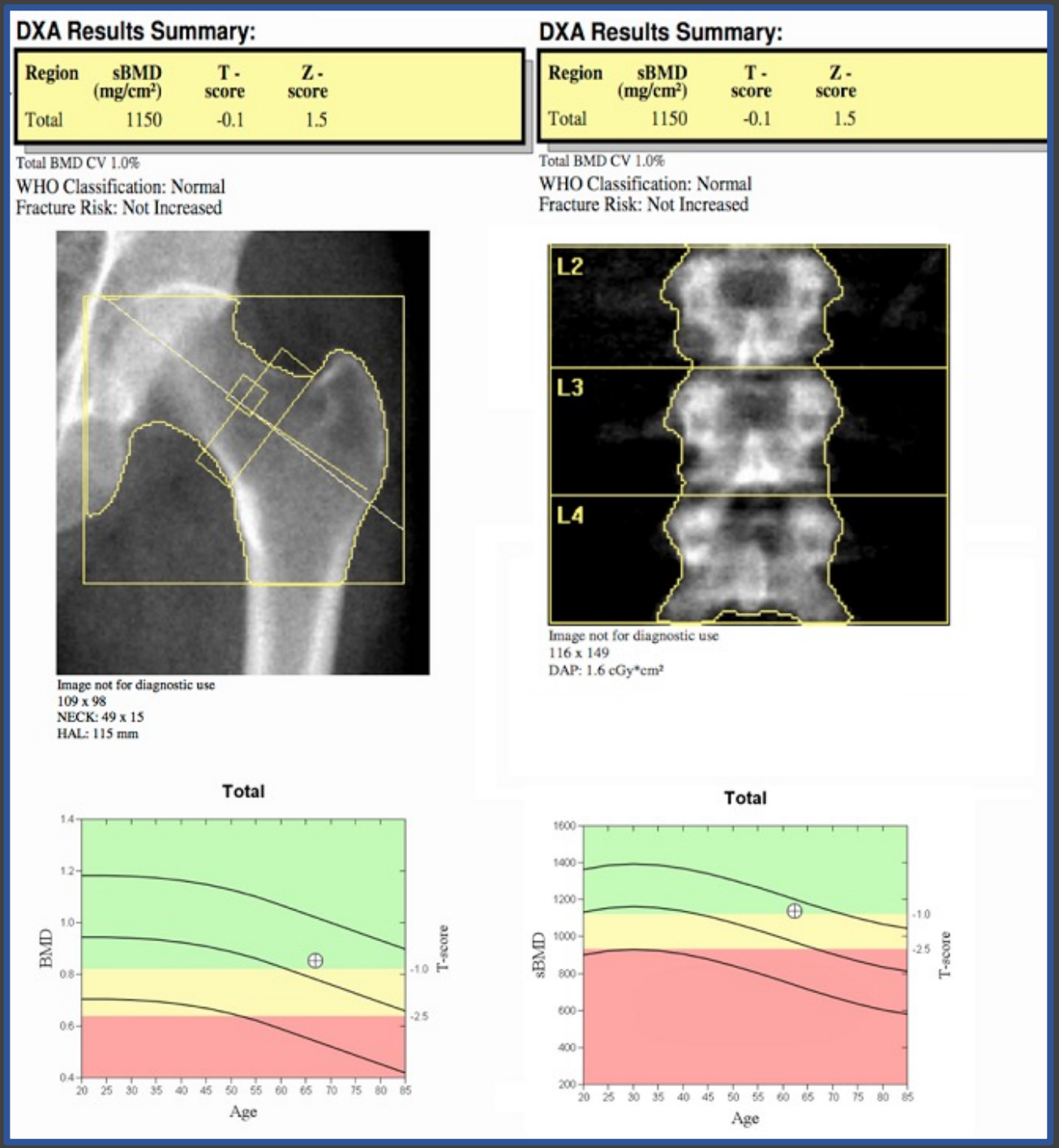
Results from Bone Health Measurement Devices

DEXA Output:
The Gold Standard

T-SCORE
Z-SCORE
BMD (g/cm²)

+/- FRAX

+/- TBS

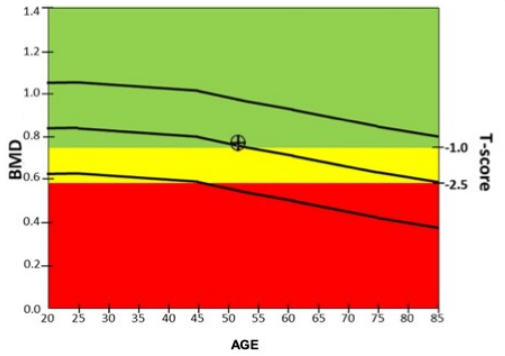


REMS Output

OSTEOSCANUK
O.U. Dr Nick Birch GMC No. 3086328

Exam date: 07/01/2021 13:51:21
Family Name:
Date of Birth: Age: 52y Gender: F Weight: 75 kg H: 173 cm BMI: 25.06 kg/m²

REMS densitometry: LEFT FEMUR



	BMD g/cm²	T-score	Z-score	Diagnosis
Neck	0.765	-0.8	0.1	Normal

	BMD	T-Score	Z-Score
Total	0.862	-0.7	-0.1
Trochanter	0.890	-0.3	0.1

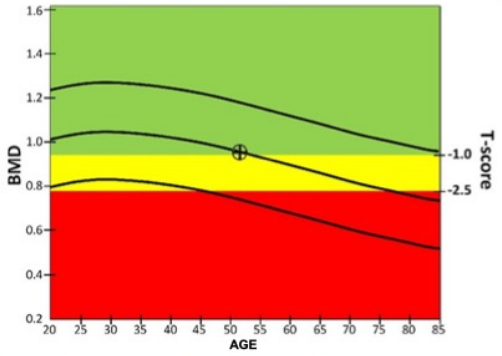
FRAX®	
Major osteoporotic	3.8%
Hip fracture	0.3%

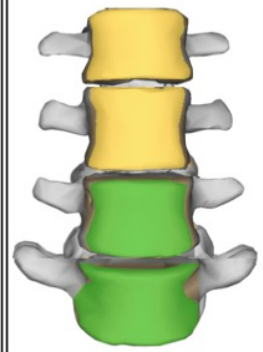
NOTES / DIAGNOSTIC RESULT

OSTEOSCANUK
O.U. Dr Nick Birch GMC No. 3086328

Exam date: 07/01/2021 13:57:04
Family Name:
Date of Birth: Age: 52y Gender: F Weight: 75 kg H: 173 cm BMI: 25.06 kg/m²

REMS densitometry: SPINE





	BMD g/cm²	T-score	Z-score	Diagnosis
Total	0.945	-0.9	0	Normal

	BMD	T-SCORE
L1	0.809	-1.1
L2	0.863	-1.5
L3	1	-0.8
L4	1.086	-0.3

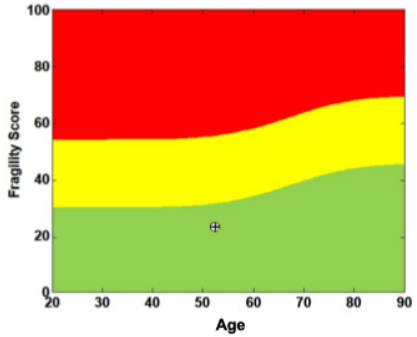
FRAX®	
Major osteoporotic	3.8%
Hip fracture	0.3%

NOTES / DIAGNOSTIC RESULT

OSTEOSCANUK
O.U. Dr Nick Birch GMC No. 3086328

Exam date: 07/01/2021 13:57:04
Family Name:
Date of Birth: Age: 52y Gender: F Weight: 75 kg H: 173 cm BMI: 25.06 kg/m²

Fragility Score REMS: Spine

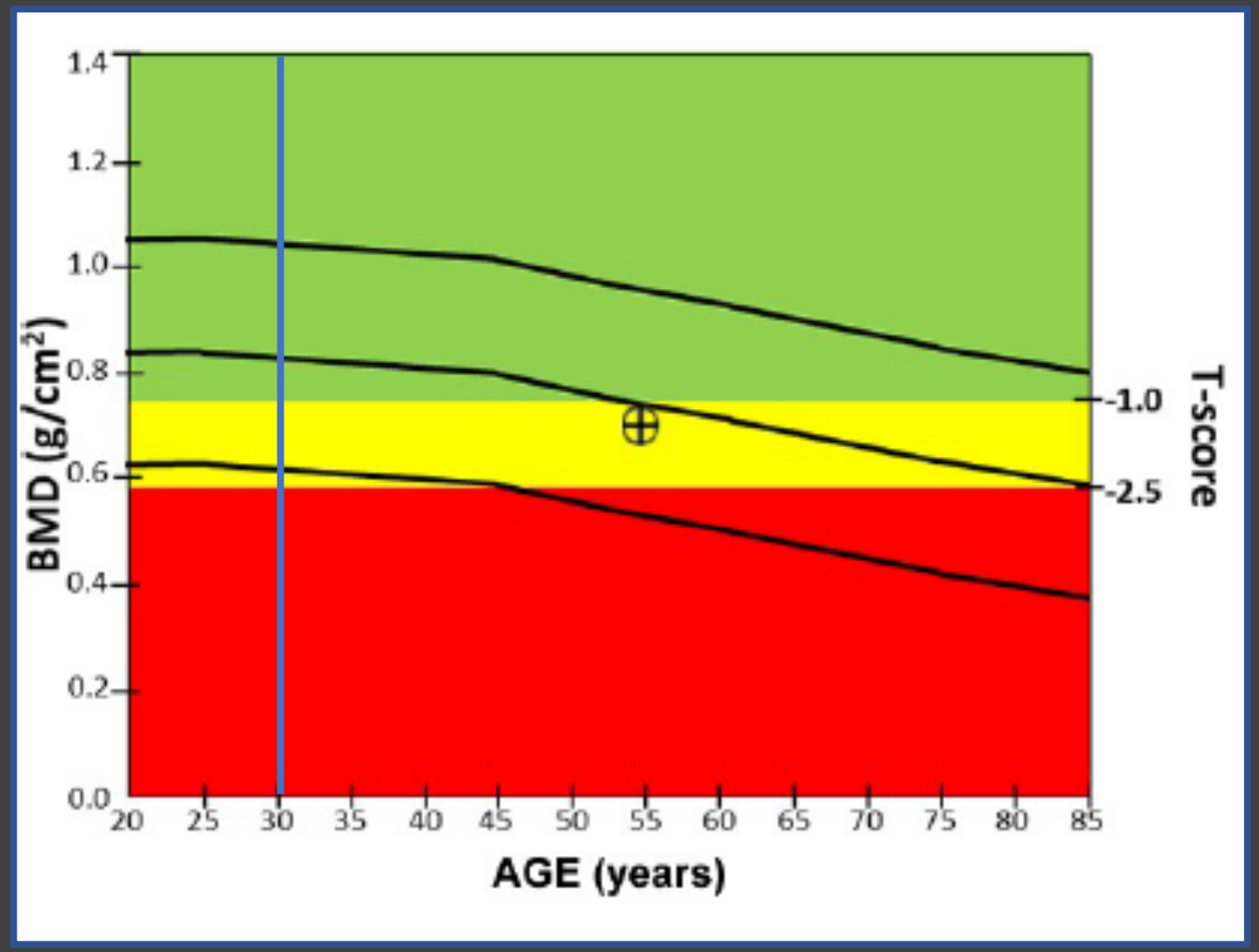


Fragility Score	23.6

Fragility Score is an indicator of the quality of bone structure independent of BMD

BMI T-SCORE Z-SCORE BMD (g/cm²) FRAX® (> 40 years) FRAGILITY SCORE

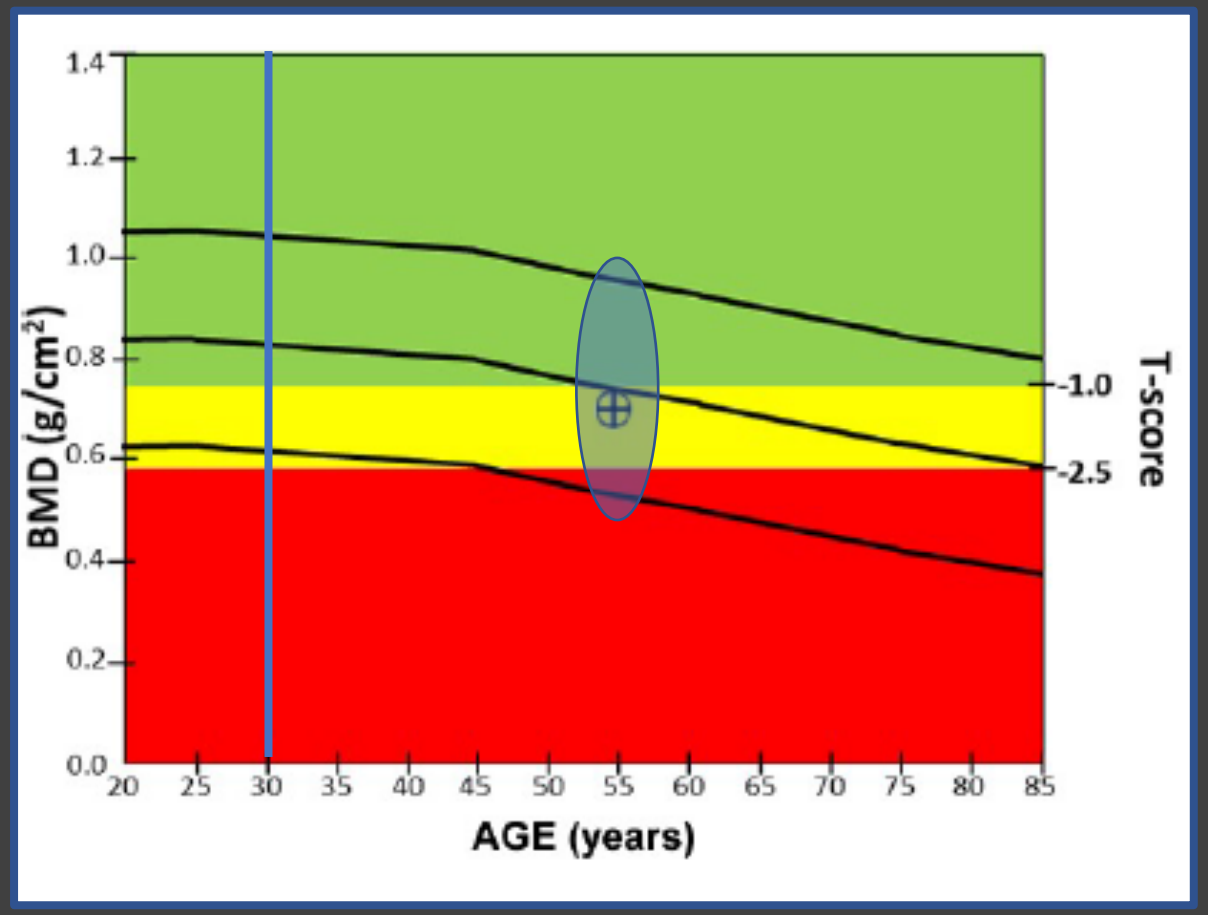
Bone Mineral Density Change With Age - NHANES III Database
Comparison with healthy 30-year-olds: T score



Bone Health Diagnosis (WHO)

	T score
Normal	> -1.0
Osteopenia	-1.0 - -2.5
Osteoporosis	< - 2.5

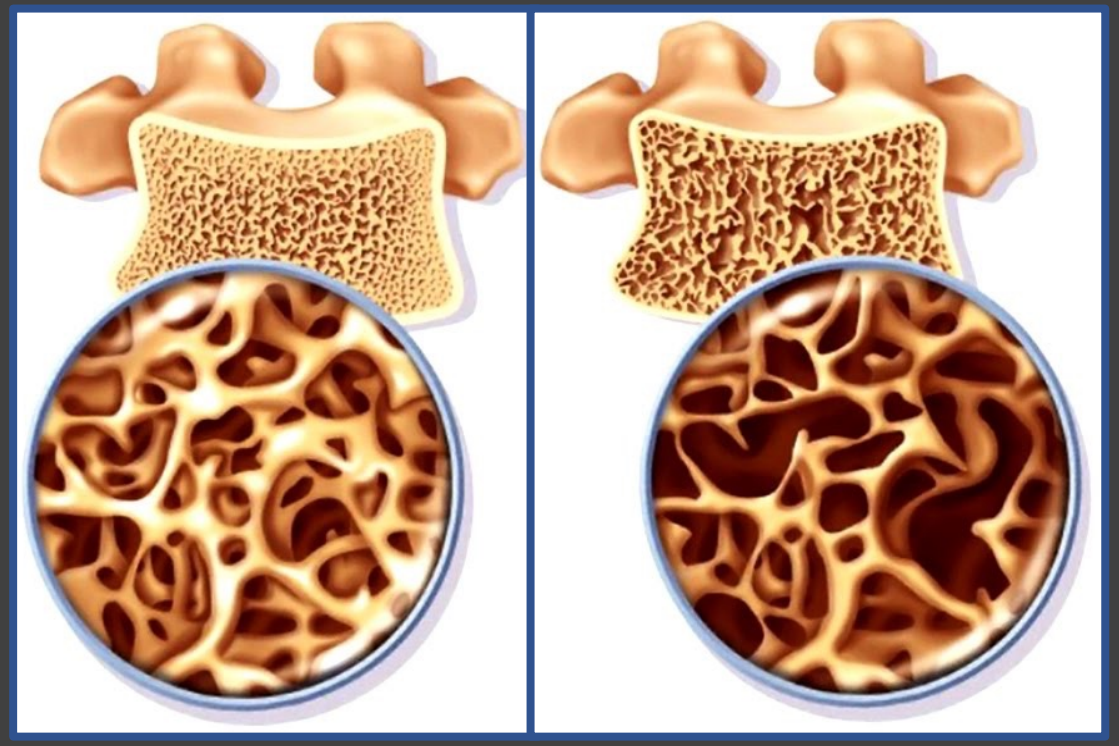
Bone Mineral Density Change With Age - NHANES III Database
Age matched: Z scores



The middle black line represents the *modal* Z score with the upper and lower black lines showing the range in which 95% of the age-matched population lie

Impaired Bone Health / Osteoporosis

Definition	Bone Mineral Density Measurement	T-Score
Normal	BMD within 1 SD of the mean bone density for young adult women	T-score ≥ –1
Low bone mass (osteopenia)	BMD 1–2.5 SD below the mean for young adult women	T-score between –1 and –2.5
Osteoporosis	BMD ≥2.5 SD below the normal mean for young-adult women	T-score ≤ –2.5
Severe or “established” osteoporosis	BMD ≥2.5 SD below the normal mean for young-adult women in a patient who has already experienced ≥1 fracture	T-score ≤ –2.5 (with fragility fracture[s])



Risk Factors for Osteoporosis

Female sex

65 years old +

A fracture after 50 years of age – *fragility fracture*

Parent(s) with a hip fracture

Early menopause - < 45 years old

Taking steroid medication

Rheumatoid Arthritis

Cigarette smoking

Heavy drinking (3 units / day and over)

Thyroid disease

Chronic liver and kidney disease

Diabetes

Malabsorption of food / Poor Nutrition (Crohn's disease / Ulcerative colitis /Coeliac disease)

Sedentary lifestyle

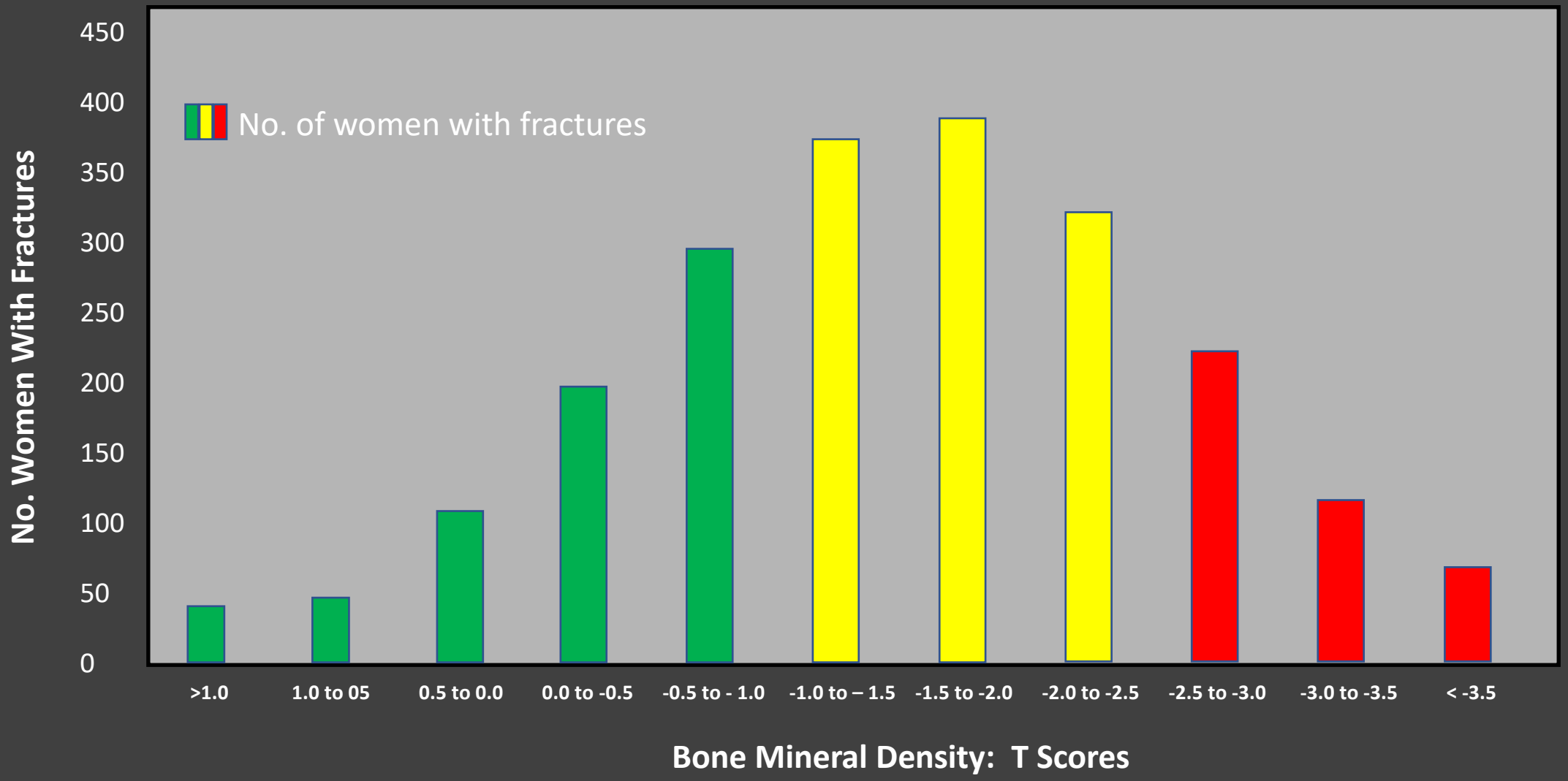
Low body weight or small stature

No periods for more than 6 months (before age 30)

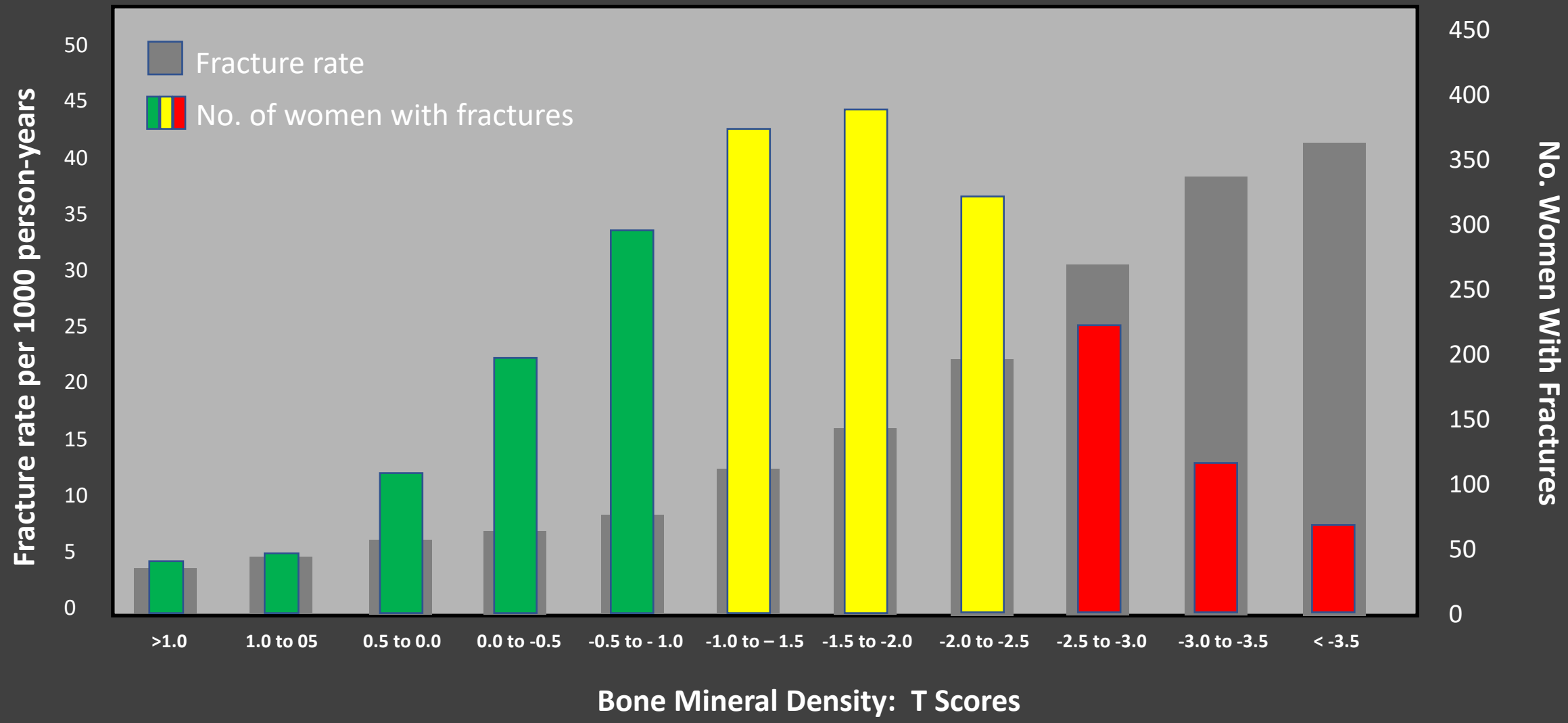
Some medications

Rate of Fractures in Women According to Bone Mineral Density

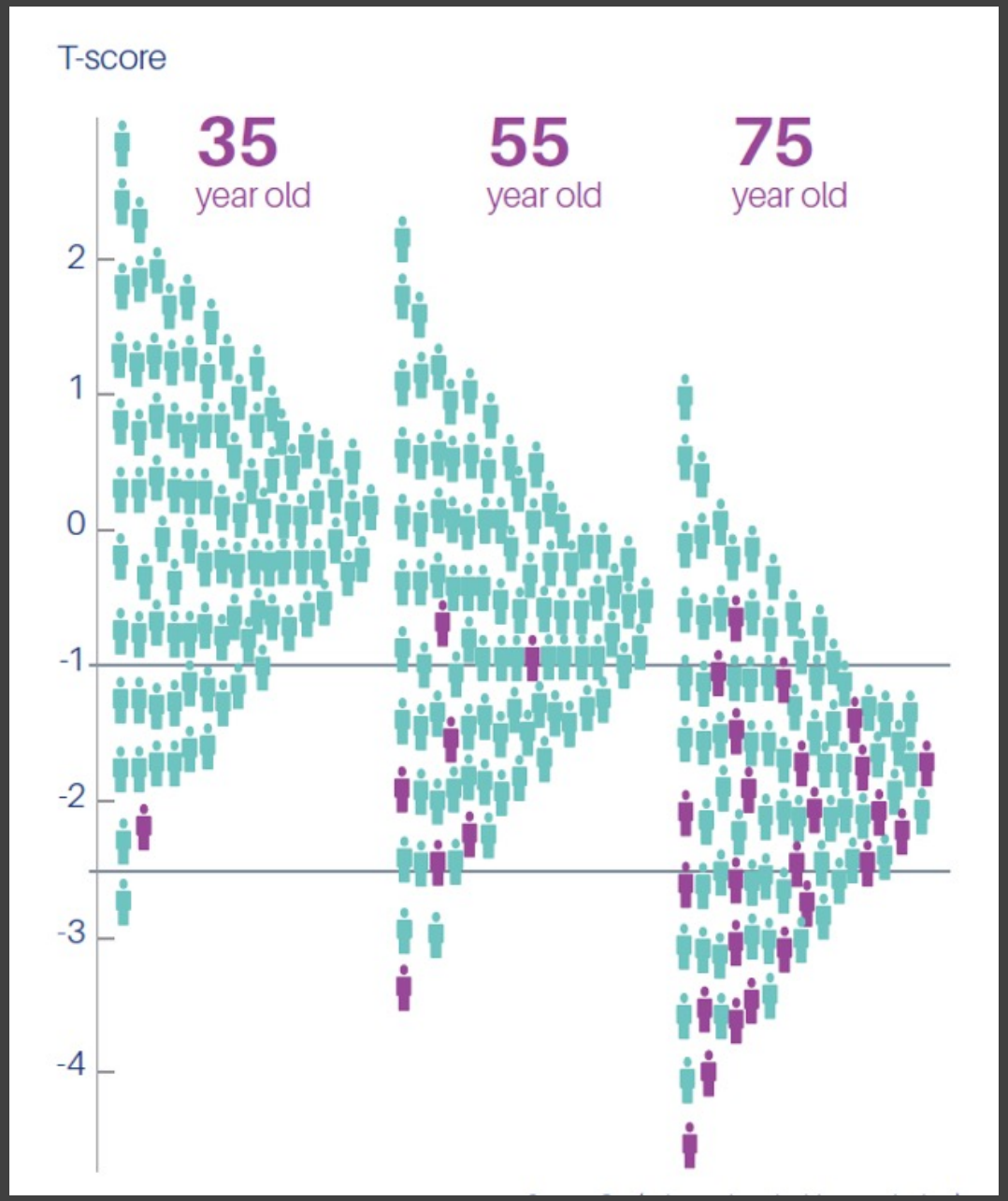
Number of Fractures in Women According to Bone Mineral Density



Rate and Number of Fractures in Women According to Bone Mineral Density



Risk of Fragility Fractures in Women According to Age

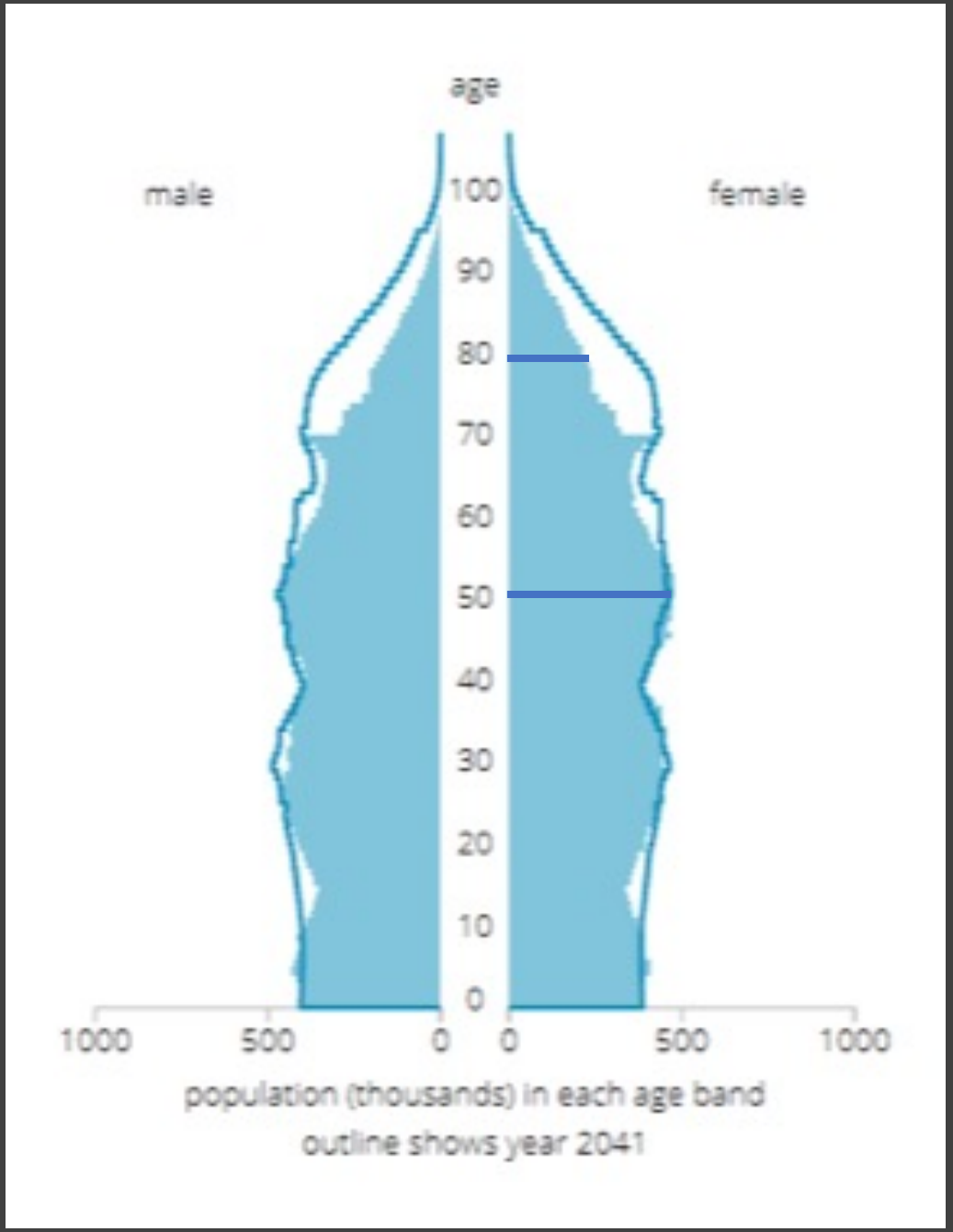


Age 35: 1 in 100

Age 55: 7 in 100

Age 75: 24 in 100

Population Distribution by Age



Impaired Bone Health: Treatment Options

Prevention – diet, exercise, treatment of secondary causes of impaired bone health

HRT – seek advice from a reasonable menopause expert e.g. Louise Newsome (Solihull)

Diet and exercise if the REMS / DEXA result is osteopenia

Consider Calcium and Vitamin D supplements plus anti-resorbtive medication (alendronic acid etc) if result is osteoporosis

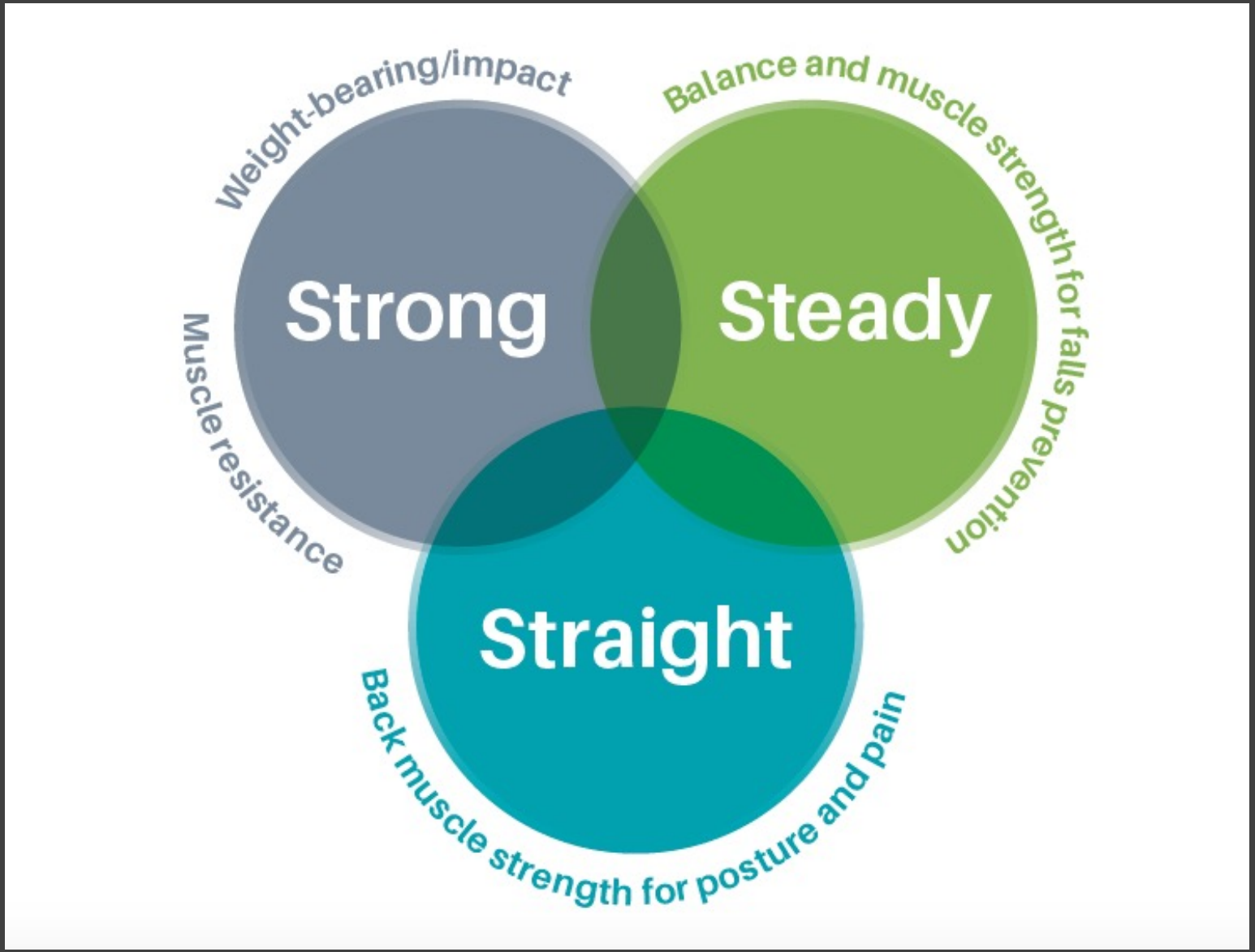
Royal Osteoporosis Society

Better bone health for everybody

Strong, Steady and Straight

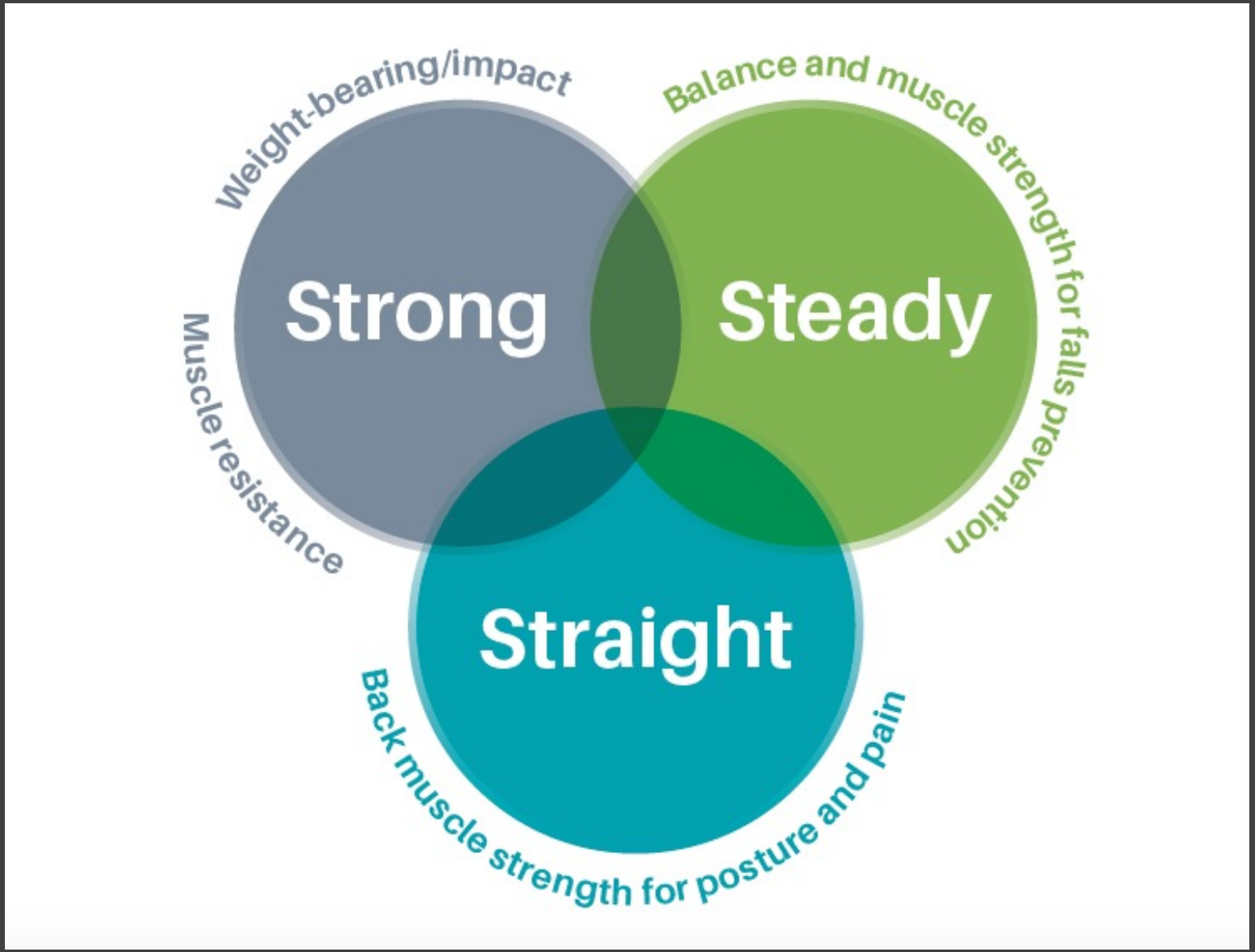
An Expert Consensus Statement on
Physical Activity and Exercise for Osteoporosis

Physical activity and exercise have important roles in the management of osteoporosis, promoting bone strength, reducing falls risk, and the management of vertebral fracture symptoms. They should form part of a broad approach that includes other positive lifestyle changes, combined with pharmacological treatment where appropriate.



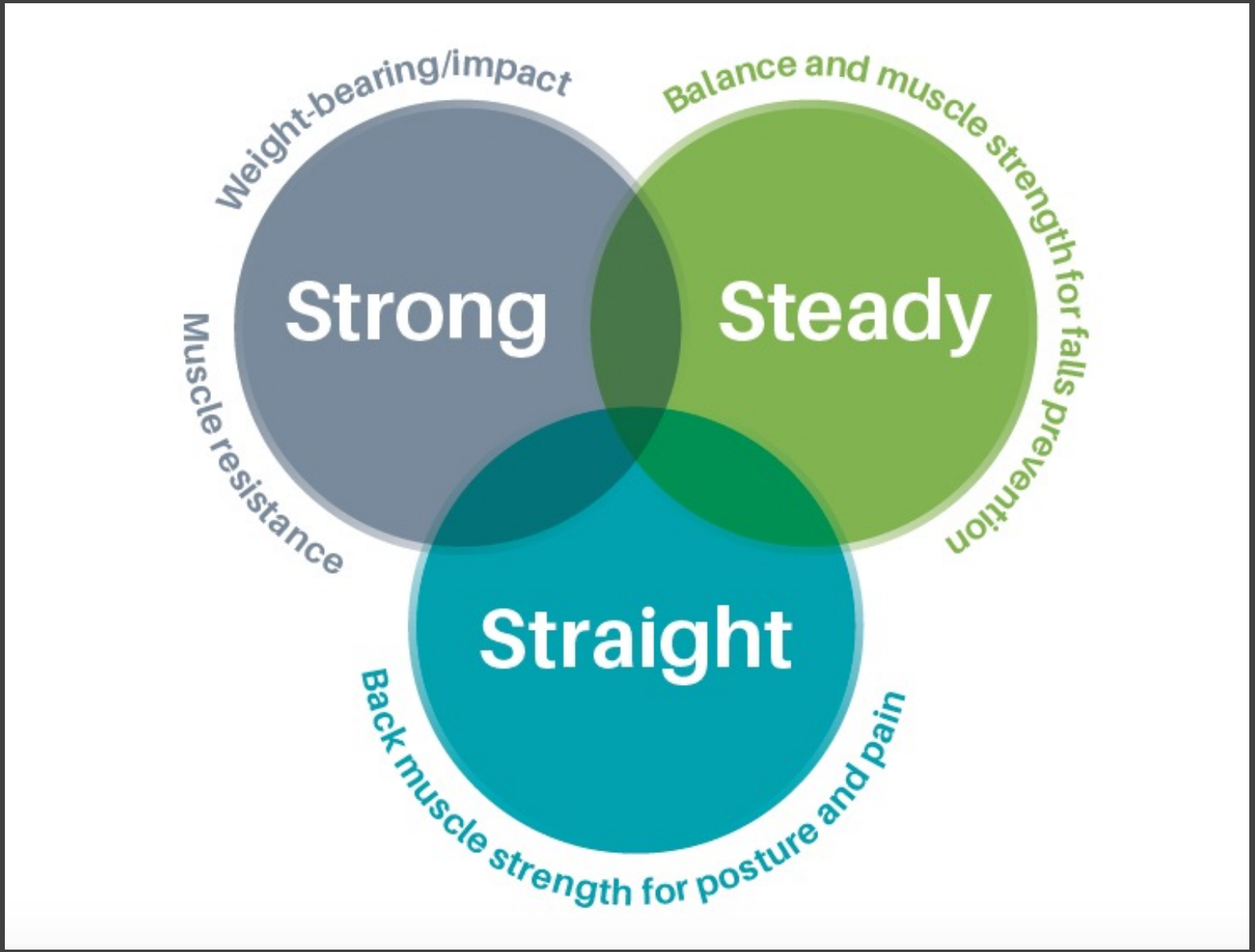
The Solution

People with osteoporosis should be encouraged to do *more* rather than *less*. This requires professionals to adopt a positive and encouraging approach, focusing on 'how to' messages rather than 'don't do'. Although specific levels and types of physical activity and exercise are likely to be most effective, even a minimal increase in activity should be encouraged to provide at least some benefit.



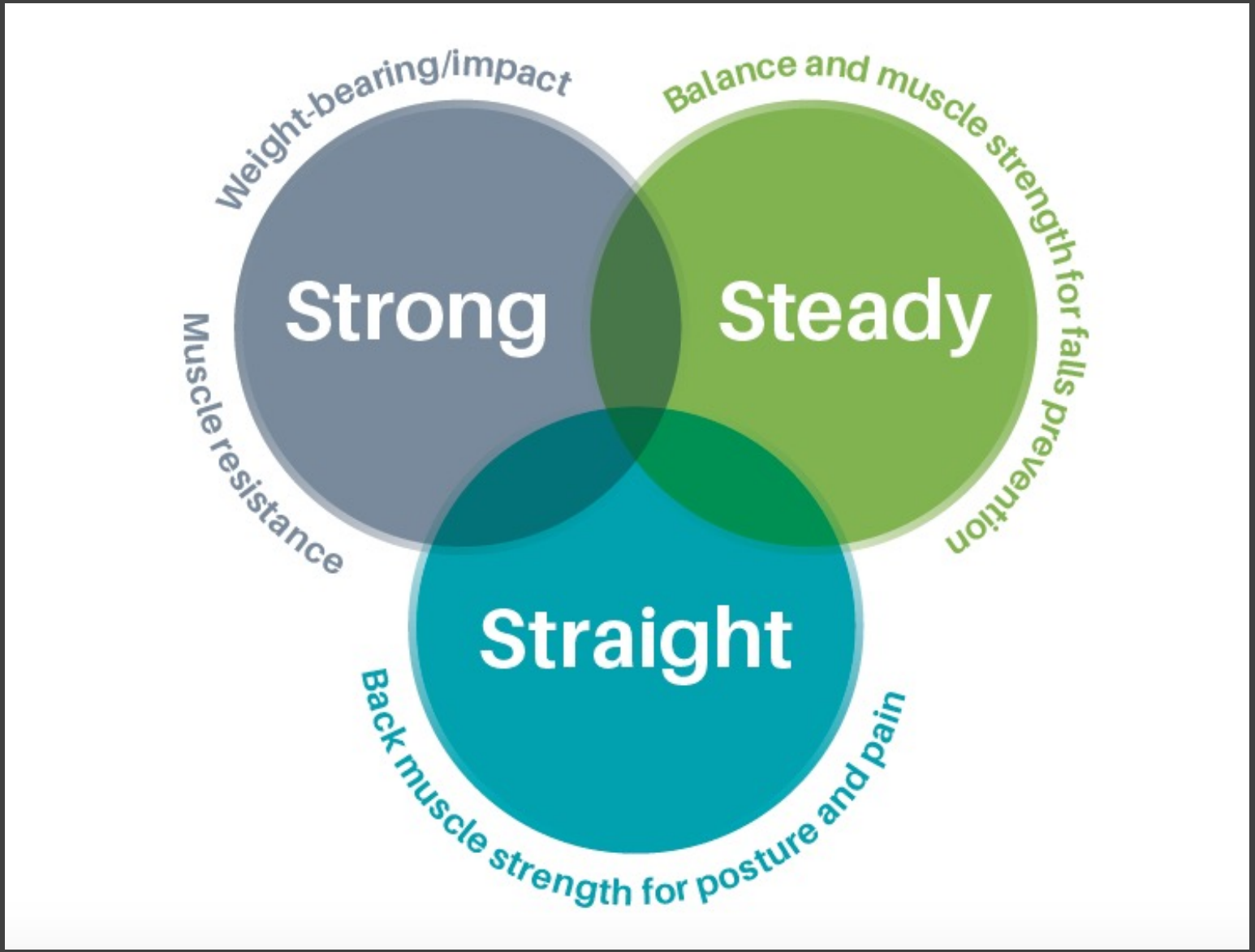
The Solution

The evidence indicates that **physical activity and exercise is not associated with significant harm, including vertebral fracture;** in general, the benefits of physical activity and exercise outweigh the potential risks.



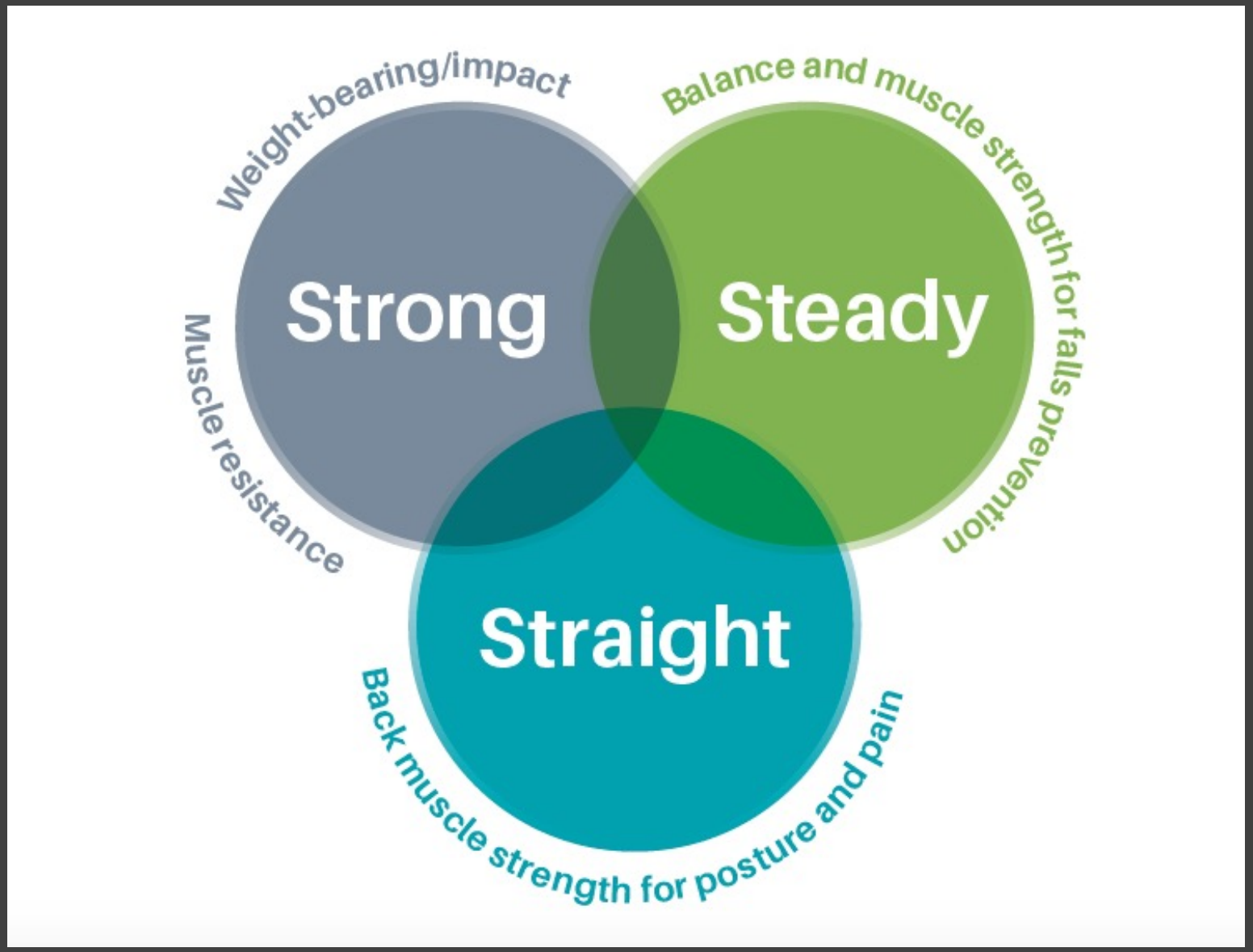
The Solution

Professionals should avoid restricting physical activity and exercise unnecessarily according to BMD or fracture risk thresholds, as this is often unhelpful and may discourage exercise or activities that promote bone as well as other health benefits.



The Solution

People with painful vertebral fractures need clear and prompt guidance on how to adapt movements involved in day-to-day living, including how exercises can help with posture and pain. Anyone with osteoporosis may benefit from guidance on amending some postures and movements to care for their back.



Concern regarding Exercise and Fractures

Overall, there is little evidence of harm, including fractures, occurring whilst exercising. Furthermore, cases that were identified comprised a mixture of people with and without osteoporosis (as defined by DXA).

Bone strengthening exercises are therefore unlikely to cause a fracture (and specifically a vertebral fracture) and do not need to be adapted for those with osteoporosis according to fracture risk or low BMD (including osteoporosis or osteopenia determined by densitometry).

Key recommendations: physical activity and exercise for osteoporosis

Strong

Build bone and muscle strength

Weight-bearing/impact exercise for bones

50 impacts per session

Frequency: Most days

With osteoporosis

Moderate impact

Lower impact

Low impact - weight bearing

Frequency: Most days

Build up gradually

Build muscle

Frequency: 2-3 days / week

Weights & resistance bands

3 sets, 8-12 reps of max weight

Progressive resistance training

Sports and everyday activities

Vertebral or multiple fractures, or less able

- Some extra caution
- Exercise up to lower impact
- Individualised advice
- Ensure safe technique

Steady

Improve balance

Activities like tai chi or dance

Frequency: 2-3 days / week

Or a challenging balance class

Positive approach

- Reassurance - 'how to' not 'don't do'
- Benefits of exercise for osteoporosis
- Keep active – something is better than nothing

- Build bone and muscle strength
- Improve balance
- Improve pain, posture and movements

Aiming for fewer fragility fractures and improved wellbeing

Straight

Improve pain, posture and movements

Manage pain from vertebral fractures

Daily back muscle strengthening exercises

Frequency: Daily

Improve posture and movements

Learn safe moving and lifting

Hip hinge for safe bending

Posture exercises

Frequency: 2-3 days / week

Use alternatives

Extreme or loaded flexion

Avoid

Inactivity and prolonged sitting

Q & A