DISORDERS OF BONE METABOLISM

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LEARNING OBJECTIVES

- ***Describe*** Osteoporosis and Osteomalacia
- List common ***causes and risk factors*** of Osteoporosis and Osteomalacia
- Discuss ***clinical features & differential diagnosis*** of Osteoporosis and Osteomalacia
- Enlist the ***Investigations*** for patient presenting with Osteoporosis and Osteomalacia

Vitamin D pathways

Diet / supplements

7-dehydrocholesterol

Vitamin D2 (ergocalciferol)

Vitamin D3 (cholecalciferol)

25-OH vitamin D (calcidiol)

1α-hydroxylase (also macrophages, monocytes, placenta)

$1,25(OH)_2$ vitamin D (calcitriol)

Increased intestinal calcium absorption

Increased bone resorption

Decreased renal calcium excretion

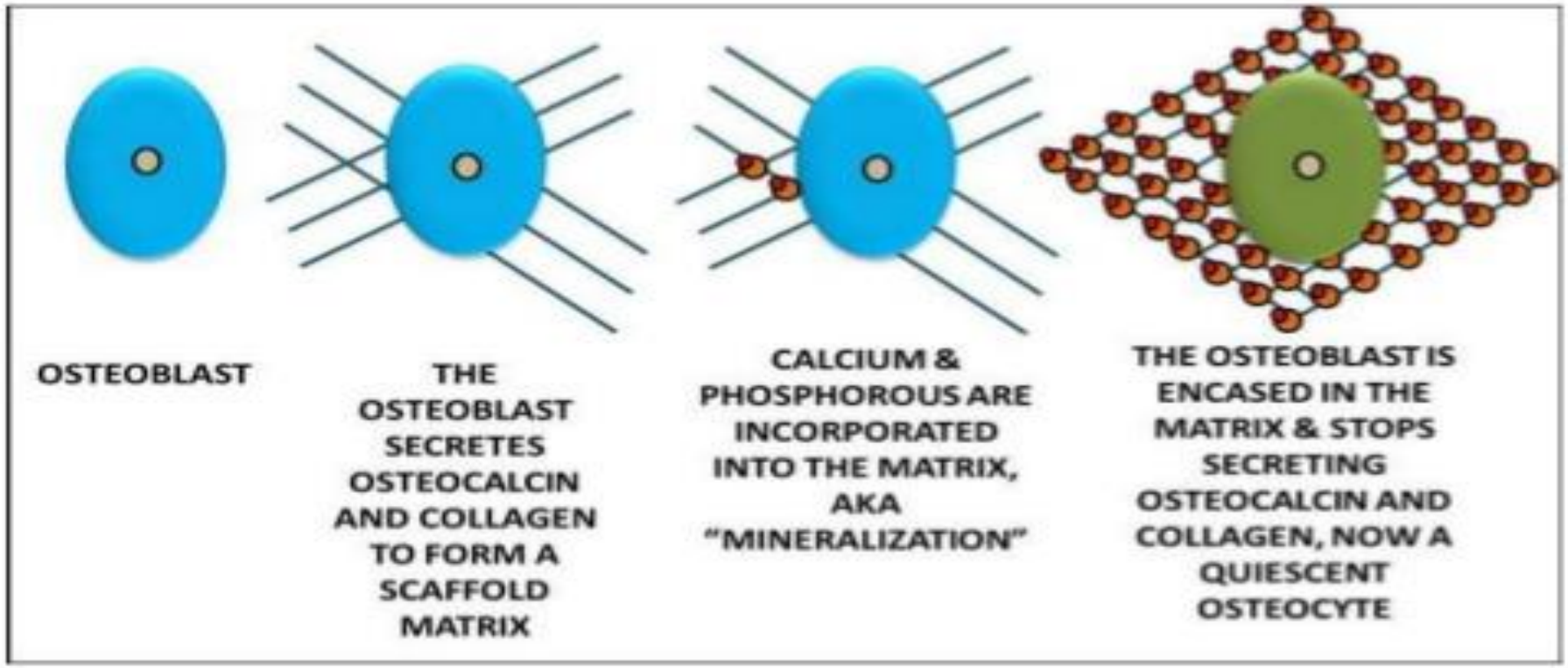
Raise serum calcium

CYP24A1

Water soluble products for excretion

@jamiekwillows

BONE FORMATION



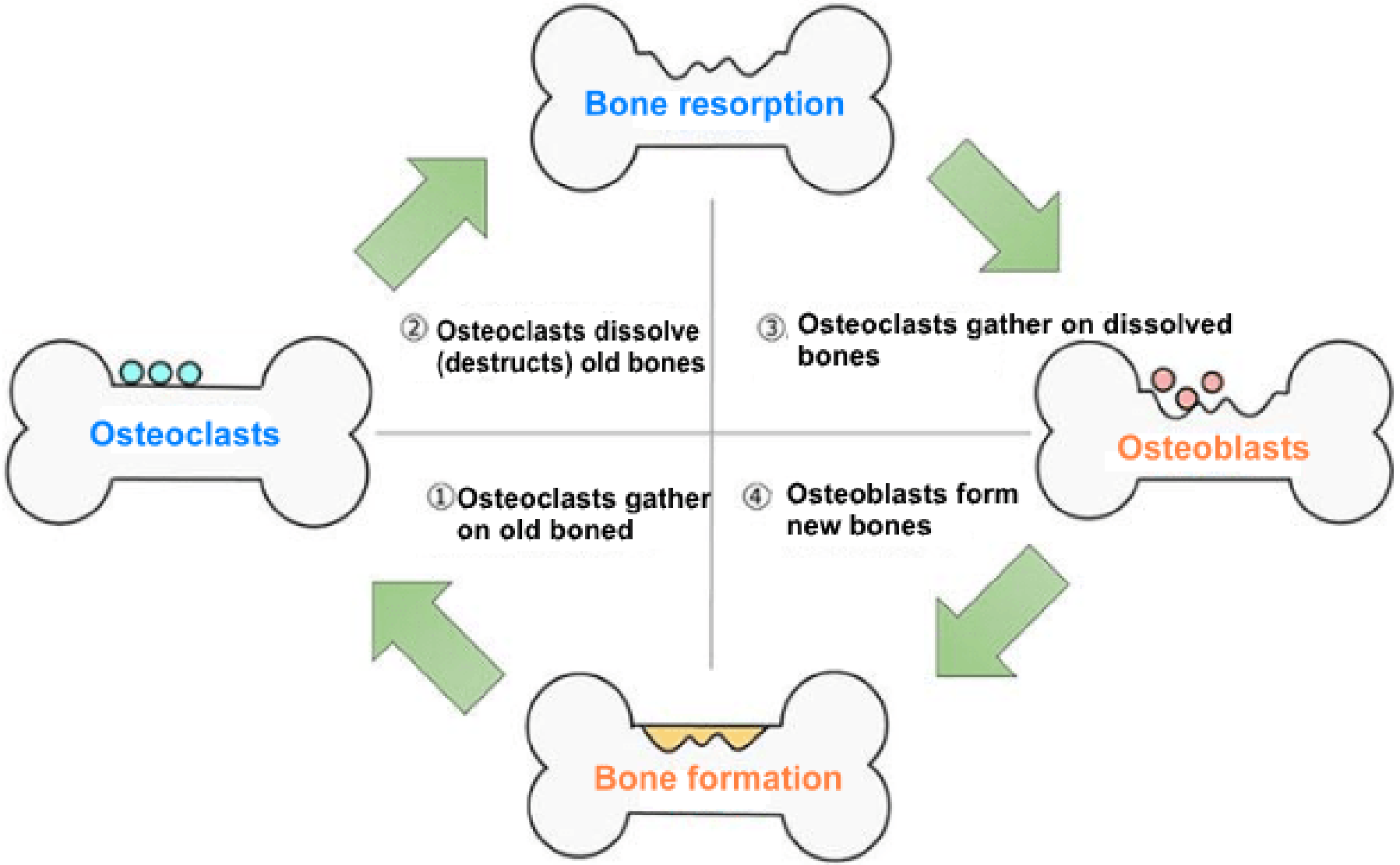
← osteoblasts

← unmineralized osteoid

\+ Ca/P

↓

← mineralized bone


Bone resorption
② Osteoclasts dissolve (destructs) old bones
③ Osteoclasts gather on dissolved bones
Osteoclasts
Osteoblasts
①Osteoclasts gather on old boned
④ Osteoblasts form new bones
Bone formation

CLASSIFICATION

- Defect in osteoid formation : scurvy
- Defect in mineralization : rickets/ osteomalacia
- Disorder with increased bone resorption : hyperparathyroidism
- Disorder with decreased bone mass : osteoporosis
- Miscellaneous : fluorosis, heavy metal poisoning, hypervitaminosis

OSTEOMALACIA

Defective mineralization of skeleton in adults

Defective calcium or phosphate deposition in osteoid matrix

ETIOLOGY

VITAMIN D DEFICIENCY

- Nutritional deficiency
- Inadequate sunlight exposure
- Malabsorption : aging, pancreatic enzyme def. , excess wheat bran
- Chronic kidney disease / chronic liver disease
- Nephrotic syndrome
- Anticonvulsants
- Vitamin D dependent rickets

DIETARY CALCIUM DEFICIENCY

ETIOLOGY

PHOSPHATE DEFICIENCY

- Nutritional deficiency
- Malabsorption / antacid therapy
- Increased renal losses
- Tumor induced osteomalacia

INHIBITORS OF MINERALIZATION

- Aluminum, bisphosphonates

DISORDERS OF BONE MATRIX

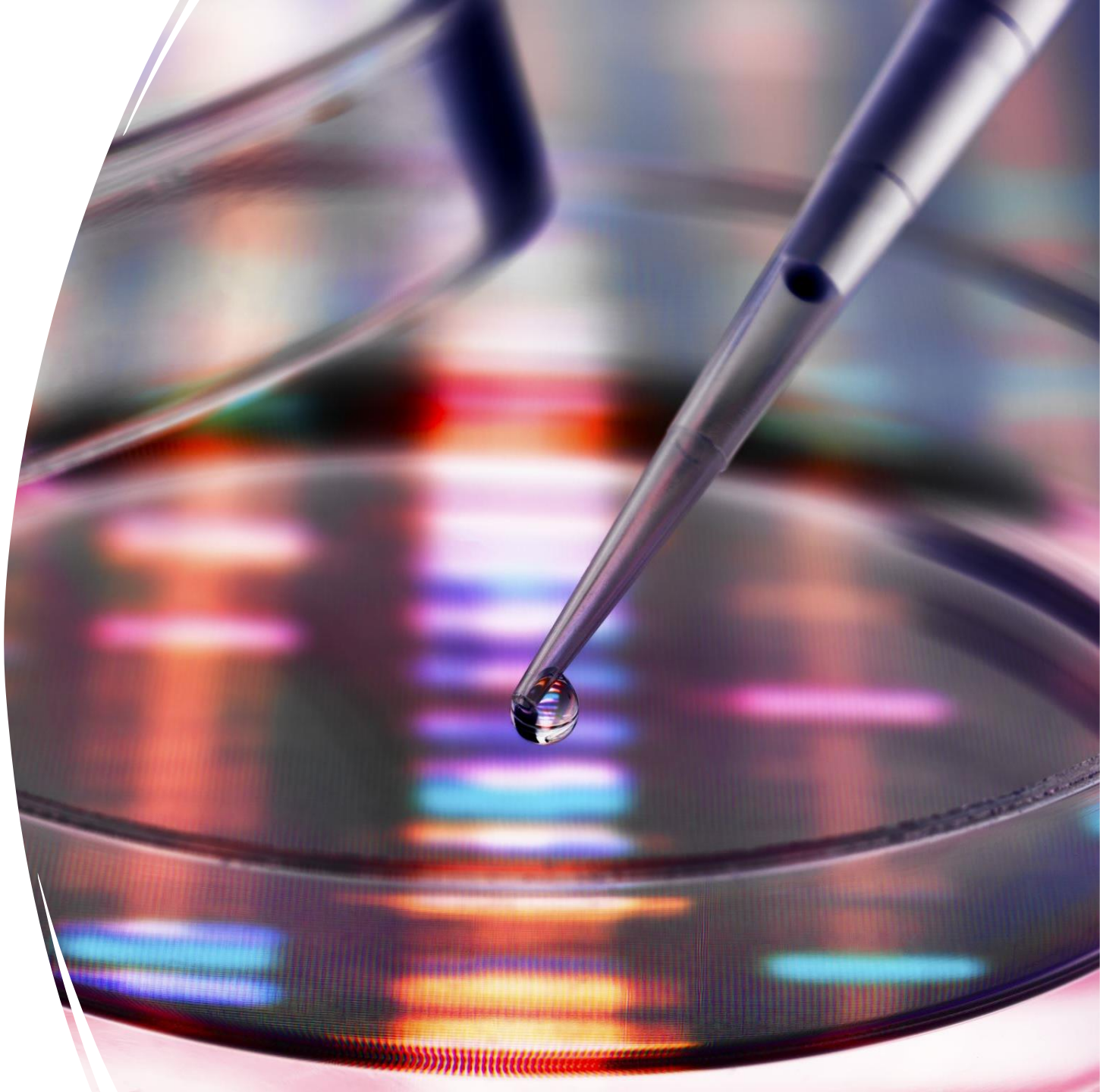
CLINICAL FEATURES

- Asymptomatic initially
- Diffuse bone and joint pains
- Proximal muscle weakness
- Pathologic fractures
- Bone & Muscle tenderness
- Waddling gait

INVESTIGATIONS

Laboratory investigations

Imaging



LABS

Serum calcium ↓

Serum phosphate ↓

Serum alkaline phosphatase ↑

Serum 25 (OH) vitamin D levels ↓

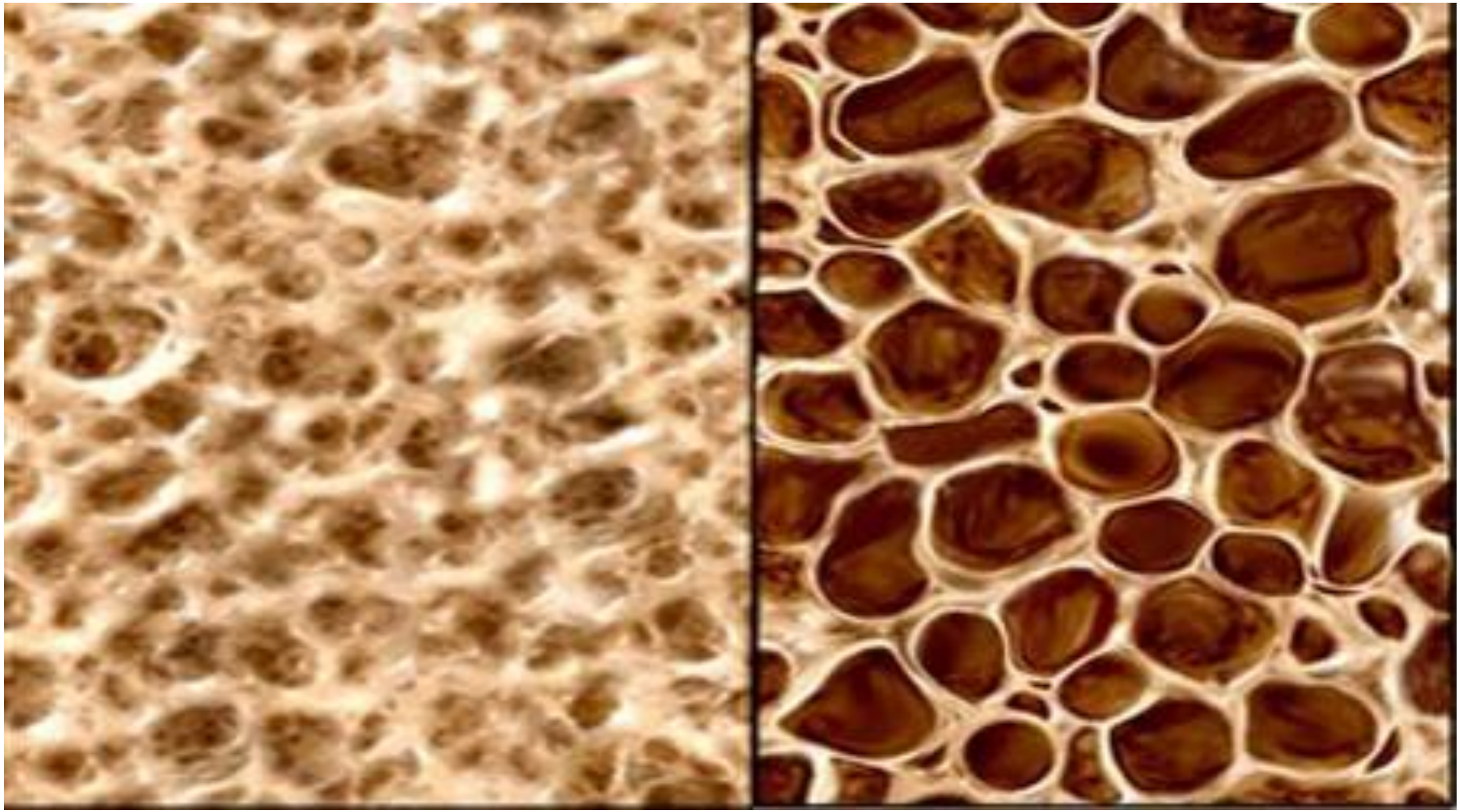
Serum PTH ↑

IMAGING

Weak osteopenic bones with thin cortex

Loosers zones / pseudofractures / Milkman’s fractures


R



INTRODUCTION

Osteoporosis is a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility

The disease often does not become clinically apparent until a fracture occurs

INTRODUCTION

The most common metabolic bone disease worldwide

Affects over 200 million people worldwide

Risk for osteoporosis increases with age

Secondary osteoporosis, however, can occur in persons of any age.

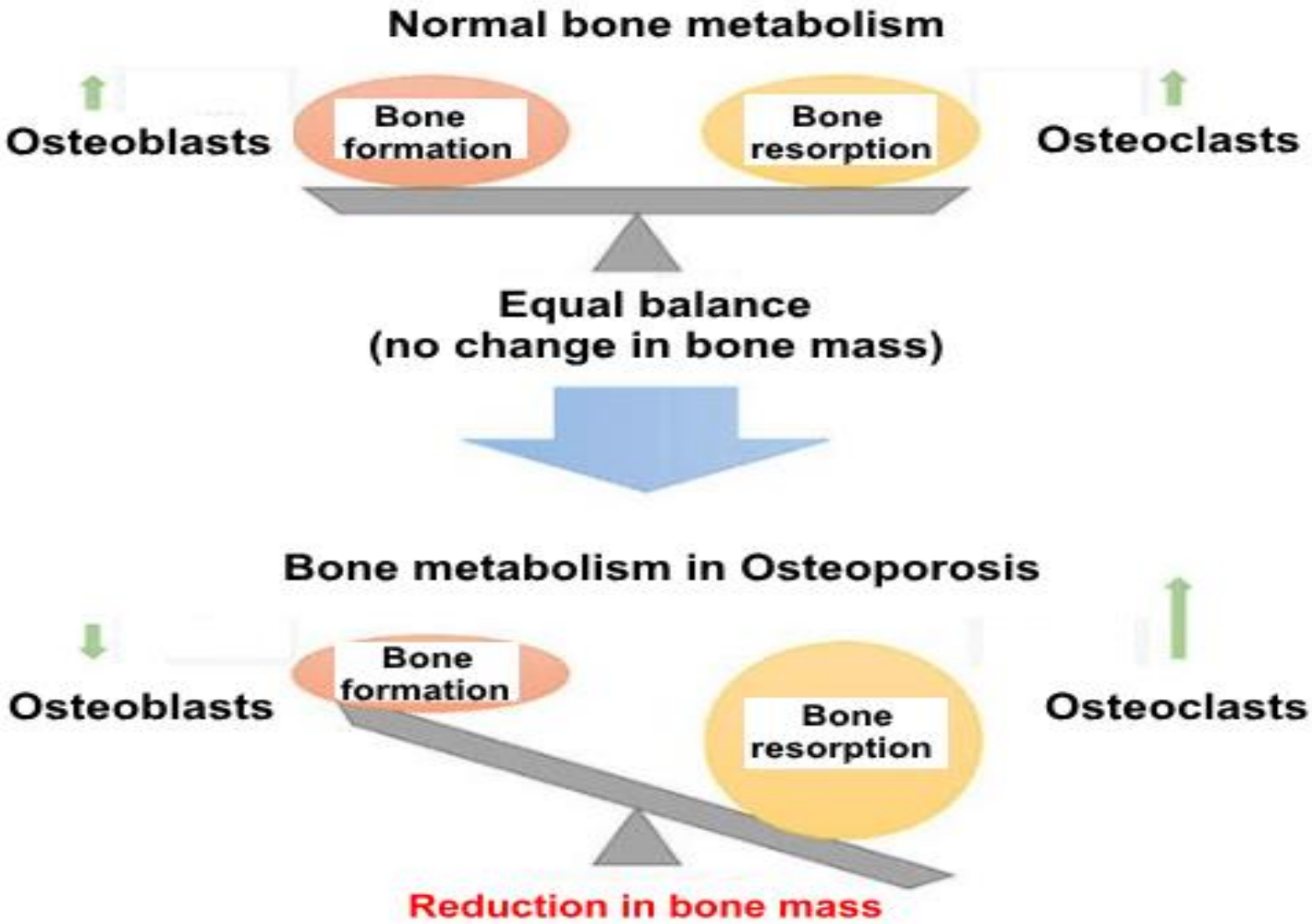
Who it affects

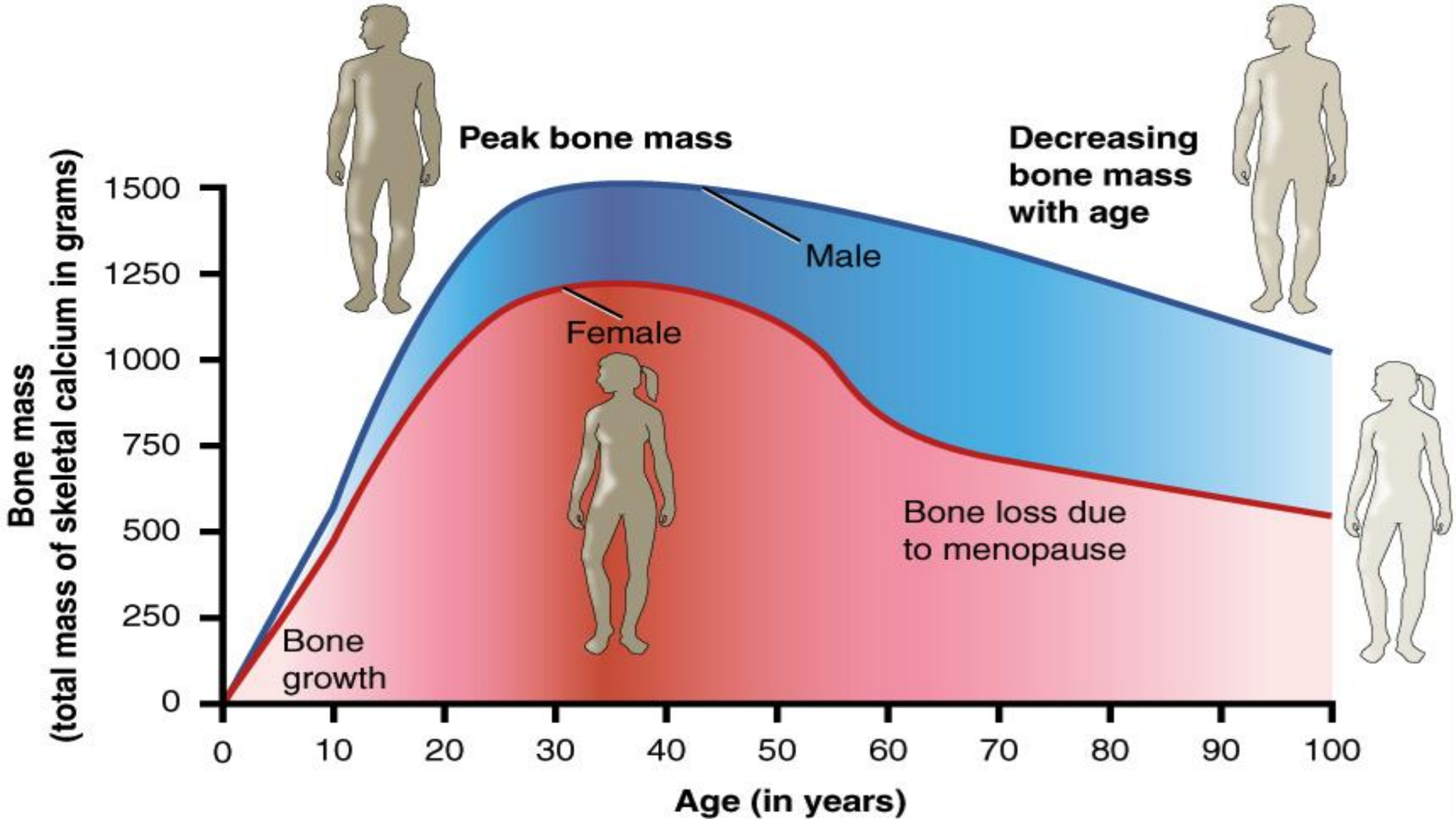
1 in 2 Women

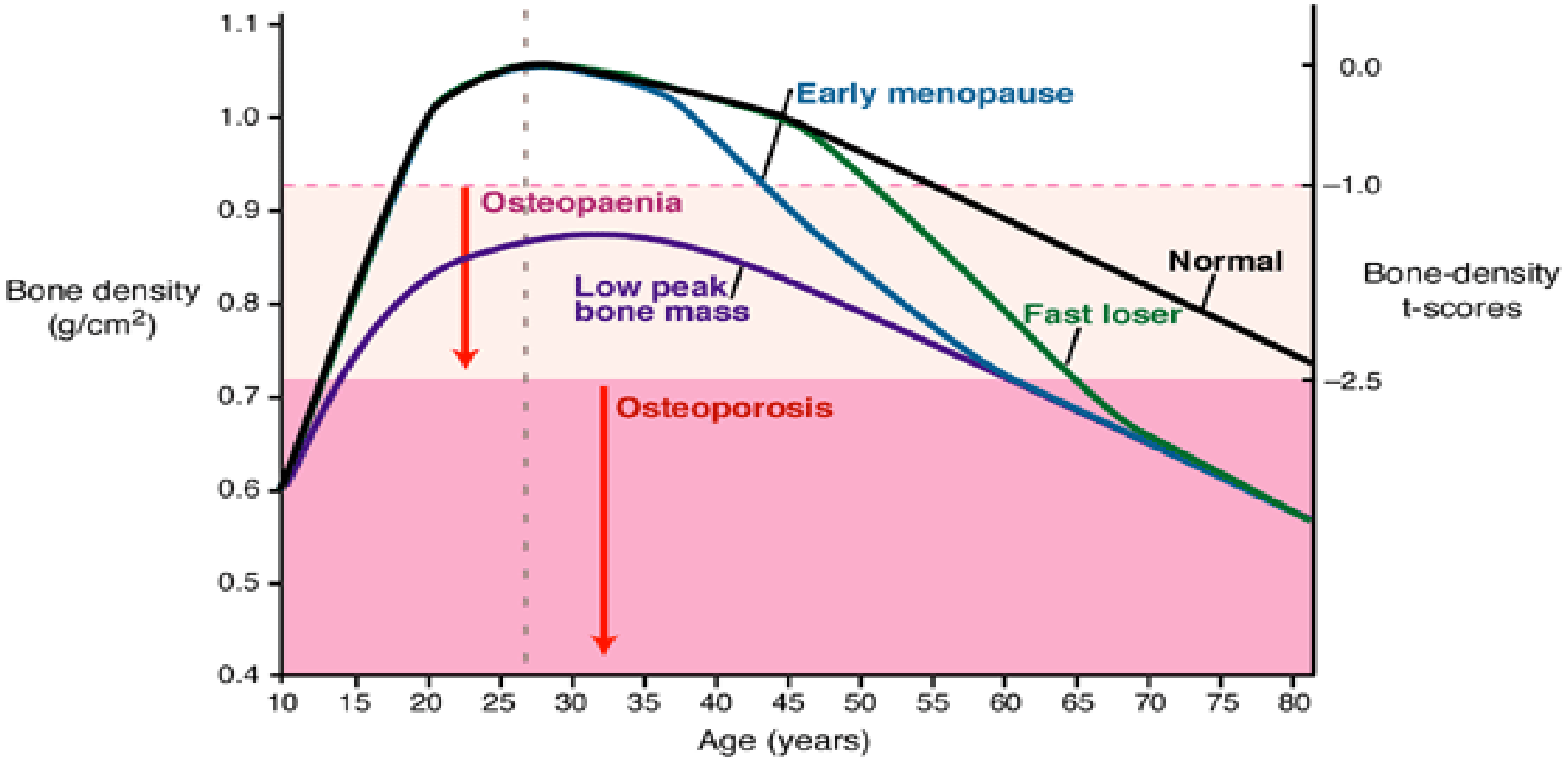
1 in 5 Men

People over the age of 50, **who will break a bone** mainly as a result of poor bone health.

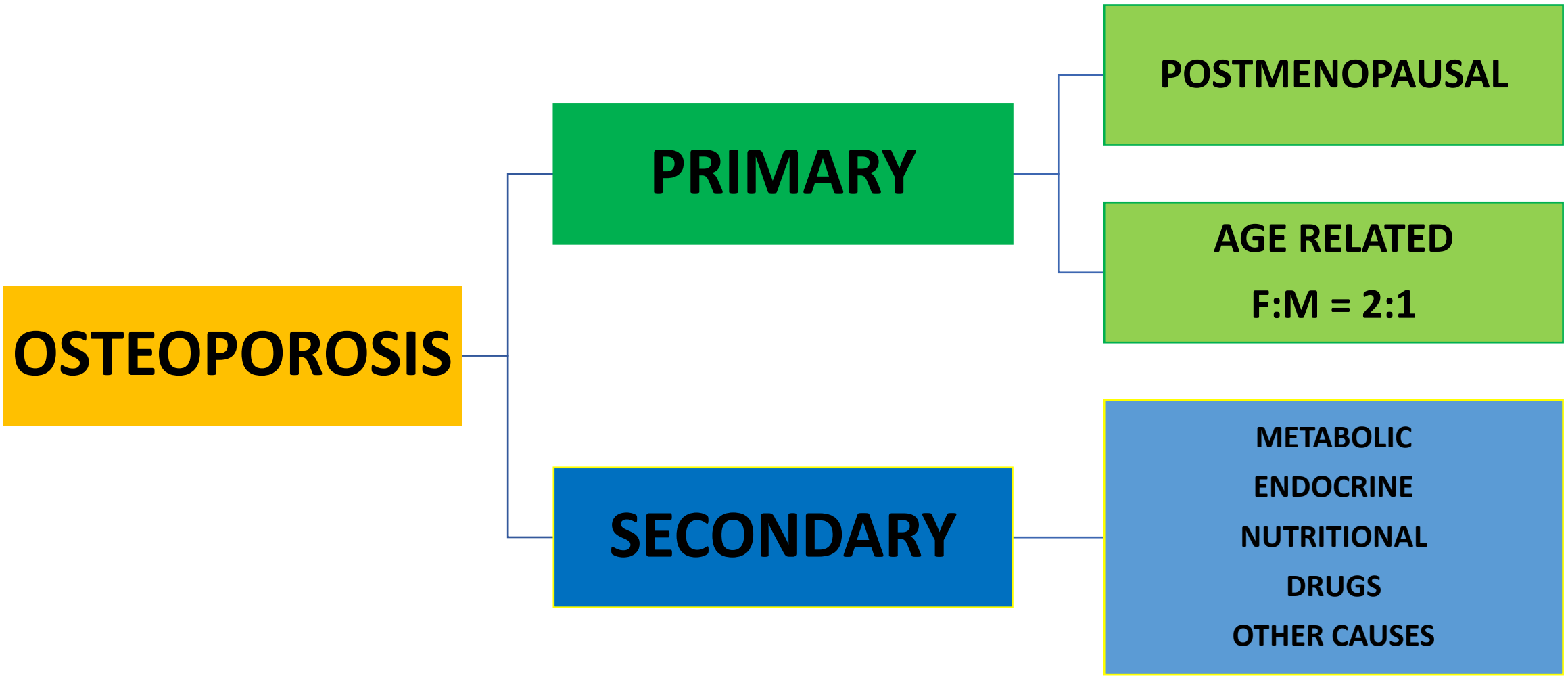
Source: The National Osteoporosis Society (NOS)


Normal bone metabolism
Osteoblasts
Bone formation
Bone resorption
Osteoclasts
Equal balance
(no change in bone mass)
Bone metabolism in Osteoporosis
Osteoblasts
Bone formation
Bone resorption
Osteoclasts
Reduction in bone mass


Peak bone mass
Decreasing bone mass with age
Male
Female
Bone loss due to menopause
Bone growth
Bone mass (total mass of skeletal calcium in grams)
1500
1250
1000
750
500
250
0
0
10
20
30
40
50
60
70
80
90
100
Age (in years)



Variation in the bone density of women at different ages


OSTEOPOROSIS
PRIMARY
SECONDARY
POSTMENOPAUSAL
AGE RELATED
F:M = 2:1
METABOLIC
ENDOCRINE
NUTRITIONAL
DRUGS
OTHER CAUSES

MOST COMMON CAUSES OF SECONDARY OSTEOPOROSIS

Diseases	Conditions	Drugs
Hypogonadism	Vitamin D deficiency	Steroid therapy
Malabsorption	Hypercalciuria	Antiepileptics
COPD	Alcoholism	GnRH agonists
Rheumatoid arthritis		Depo-Provera
Cholestatic liver disease		Aromatase inhibitors
Hyperthyroidism		Excess thyroxine
Hyperparathyroidism		
Myeloma		

NON-MODIFIABLE

- Personal history of fracture as an adult
- History of fracture in a first-degree relative
- White race
- Advanced age
- Female gender
- Dementia

MODIFIABLE

- Smoking
- Low body weight
- Estrogen deficiency
- Low calcium intake
- Alcoholism
- Inadequate physical activity
- Poor health or frailty

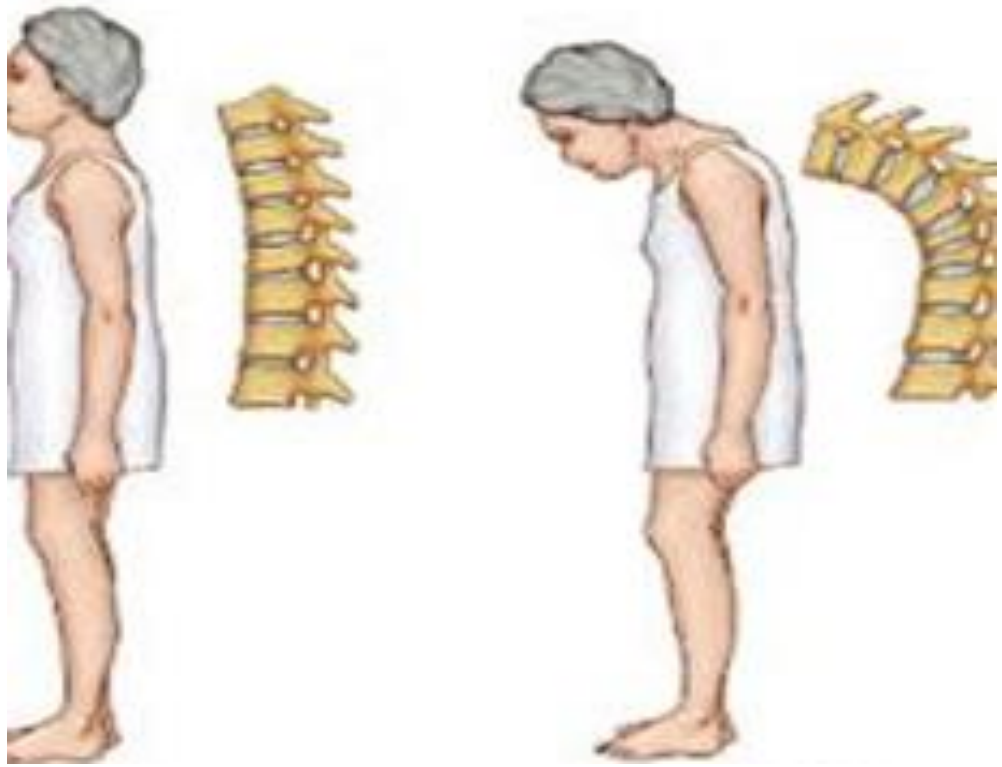
CLINICAL PRESENTATION

Many patients are unaware they have osteoporosis until they suffer a fracture

Fractures can occur after bending, lifting & falling, or independent of any activity

Pain, especially back ache

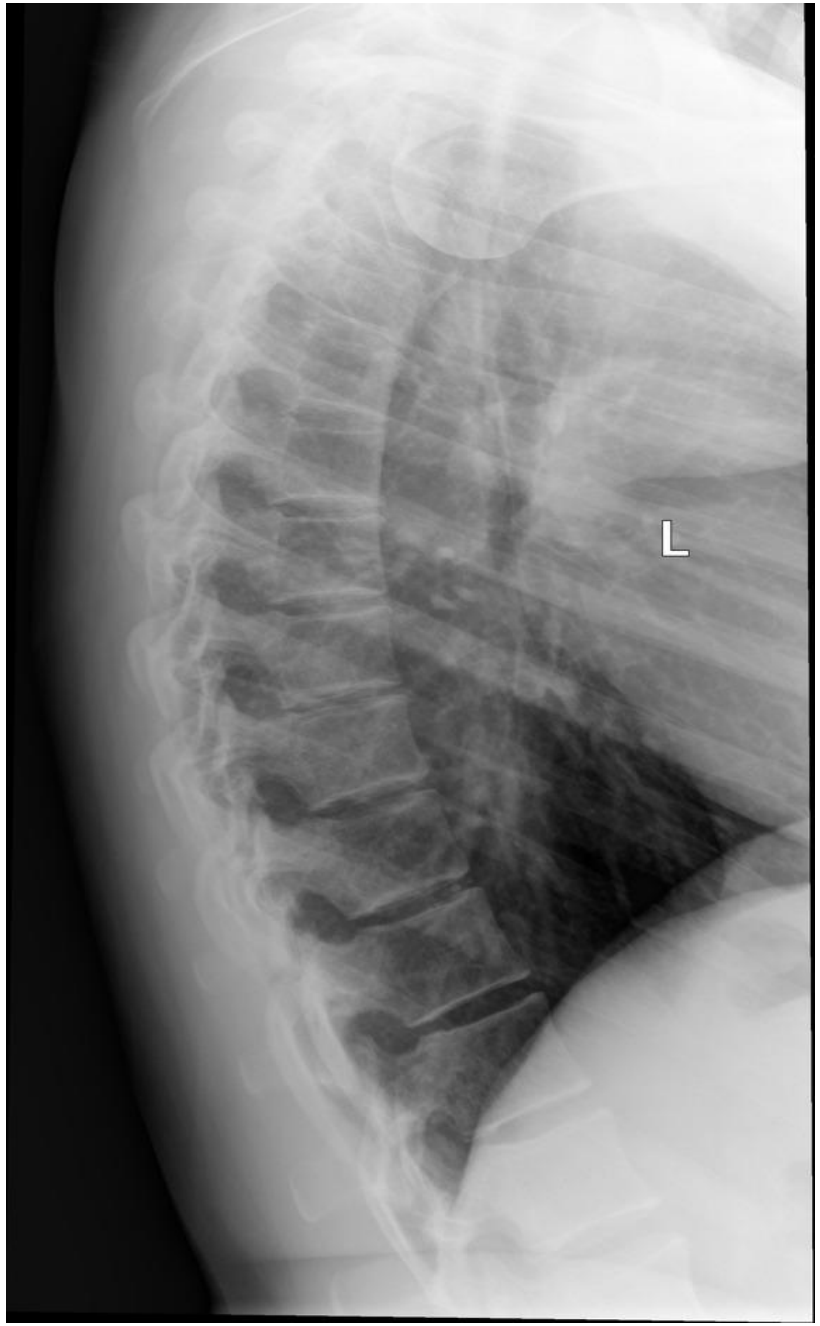
Loss of height & stooped fractures



WORK UP

IMAGING

- Plain radiographs
- DEXA Scan
- Quantitative Computed Tomography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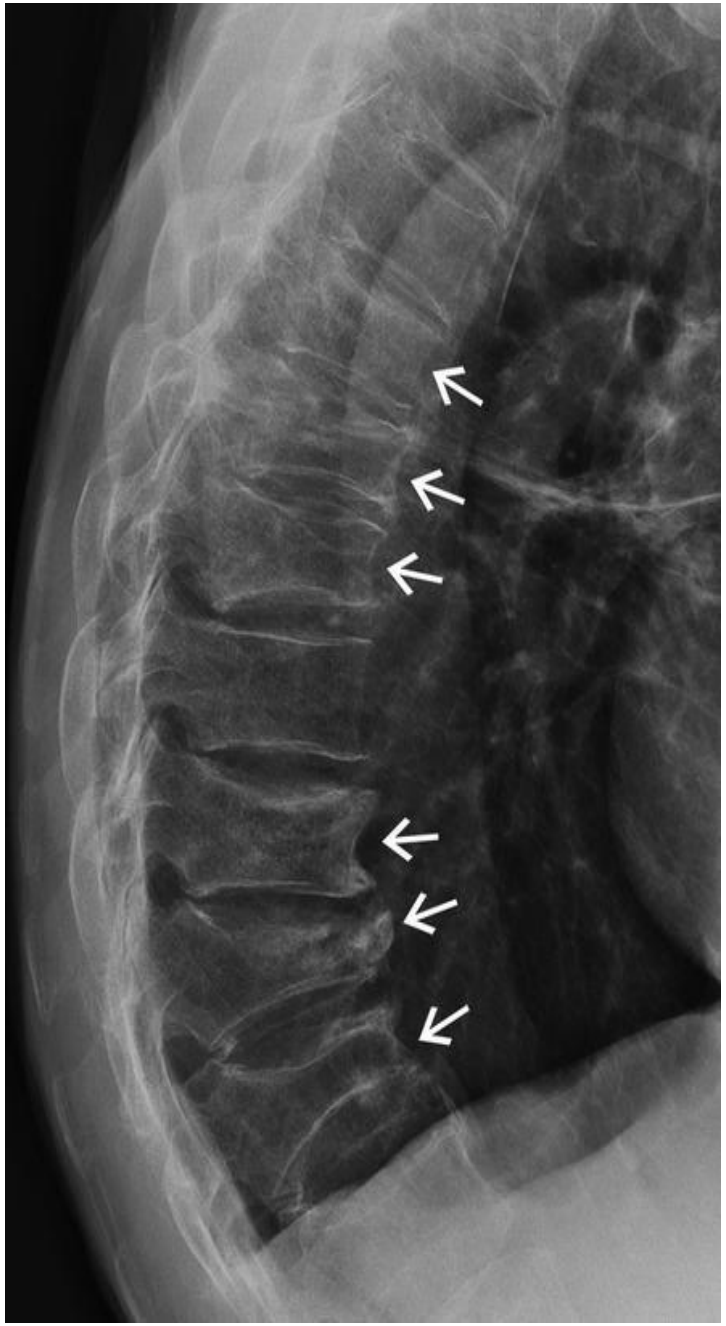

WORK UP

LABS

- Serum calcium, phosphorus, alkaline phosphatase and PTH are normal
- Concomitant vitamin D deficiency
- Appropriate testing for underlying / associated conditions

CHARACTERISTIC	OSTEOMALACIA	OSTEOPOROSIS
Definition	Bone softening caused by lack of calcification	Decreased bone mass caused by multiple factors
Primary pathology	Lack of vitamin D	Lack of Ca, Estrogen or Testo.
Symptoms	Aches / pains, muscles and bones	Asymptomatic until fracture
Radiographic findings	Fractures	Osteopenia, Fractures
Calcium level	Low (Normal)	Normal (Low)
Phosphorus level	Low (Normal)	Normal
Vitamin D level	Low	Normal (Low)
PTH level	High	Normal
Alkaline phosphatase	High	Normal