

# Overview of Osteoporosis (in Elderly)

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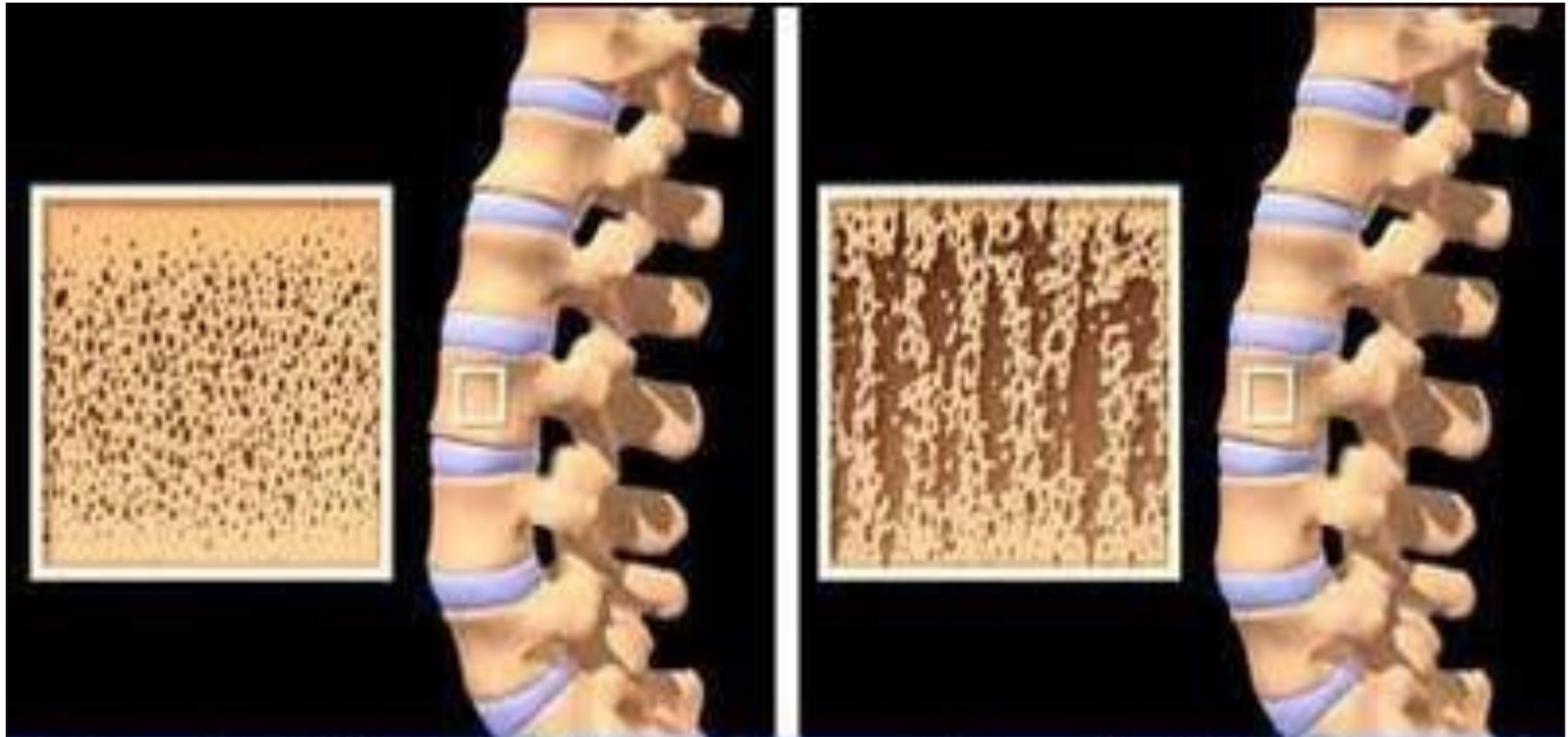
# SLO's

- Etiopathogenesis, clinical presentation, identification, functional changes, acute care, stabilization, management of osteoporosis, degenerative joint disease, and common fractures in the elderly.

- **OSTEOPOROSIS**
- Osteoporosis causes more open and porous bones resulting in fractures.
- - major cause of disability, morbidity and mortality in older people and females.
- Current world wide socioeconomic problem !
- Increasing severity and frequency due to : lifestyle [indoor/faulty], stress and progressive aging of the world's population.

- Health of bones depends on - the **genes**, the level of **hormones** in the body, **physical activity** and **diet** of an individual.
- Estimates in a study suggest that 20% of women and about 10-15% of men are osteoporotic in India.
- 26 million Indians suffer from osteoporosis, and this number is expected to reach 36 million in coming years (silent killer)

Normal bone has the appearance of a honeycomb matrix (left). Under a microscope, osteoporotic bone (right) looks more porous



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## **Osteoporosis** - disease characterized by

- low bone mass,
  - low bone mineral density [microarchitectural deterioration],
  - enhanced bone fragility and
  - increased susceptibility to fractures mainly of the hip, spine and wrist.
- 
- It does not become clinically apparent until a fracture occurs.
- 
- Screening of at-risk populations is therefore essential !

Types:

It is of primary or secondary type.

- Primary osteoporosis: Type I and Type II.
- **Type I** occurs only in **women** (menopausal) : decreased estrogen and increased osteoclast activity, from age 50 to 70.
- **Type II** most commonly affects **men and women over the age of 75** - decreased osteoblast activity and decreased bone formation.

- **Secondary osteoporosis**, is secondary to other underlying diseases, a few of which are:
- secondary hyperparathyroidism,
- diabetes mellitus,
- glucocorticoid intake,
- excessive thyroid hormone therapy,
- hypogonadism,
- hypoestrogenemia, and tamoxifen.

# CAUSES

The strength of the bones- depends on their **size** and **density** and **peak bone mass** achieved in early years of life ;

Bone density depends in part, on the amount of calcium, phosphorus and other minerals in bones.

When the bones contain fewer minerals than normal, they're less strong and eventually lose their internal supporting structure.

**Table 1. Risk Factors for Osteoporosis and Drugs causing Osteoporosis<sup>10-12</sup>**

**Nonmodifiable**

- Advanced age ( $\geq 50$  years)
- Female sex
- White or Asian ethnicity
- Genetic factors as family history of osteoporosis
- Dementia

**Potentially modifiable**

- Cigarette smoking
- Low body weight ( $< 58$  kg or 127 lb)
- Recurrent falls
- Inadequate physical activity
- Estrogen deficiency
- Drugs\*
- Alcohol use
- Early menopause
- Prolonged premenopausal amenorrhea
- Androgen or estrogen deficiency
- Calcium deficiency
- Poor health

\*Drugs: Anticonvulsants (phenytoin, carbamazepine, phenobarbitone, valproate), heparin, lithium, chemotherapeutic agents, cyclosporine, systemic steroids, thyroxine supplements, GnRH agonist, aromatase inhibitors.

# The process of bone remodeling

Scientists have yet to learn details of the process involving bone formation.

Bone is continuously changing —

new bone is made and old bone is broken down - a process of remodelling / bone turnover.

A full cycle of bone remodelling takes 2-3 months.

In young – the body makes new bone faster than it breaks down old bone, and the bone mass increases.

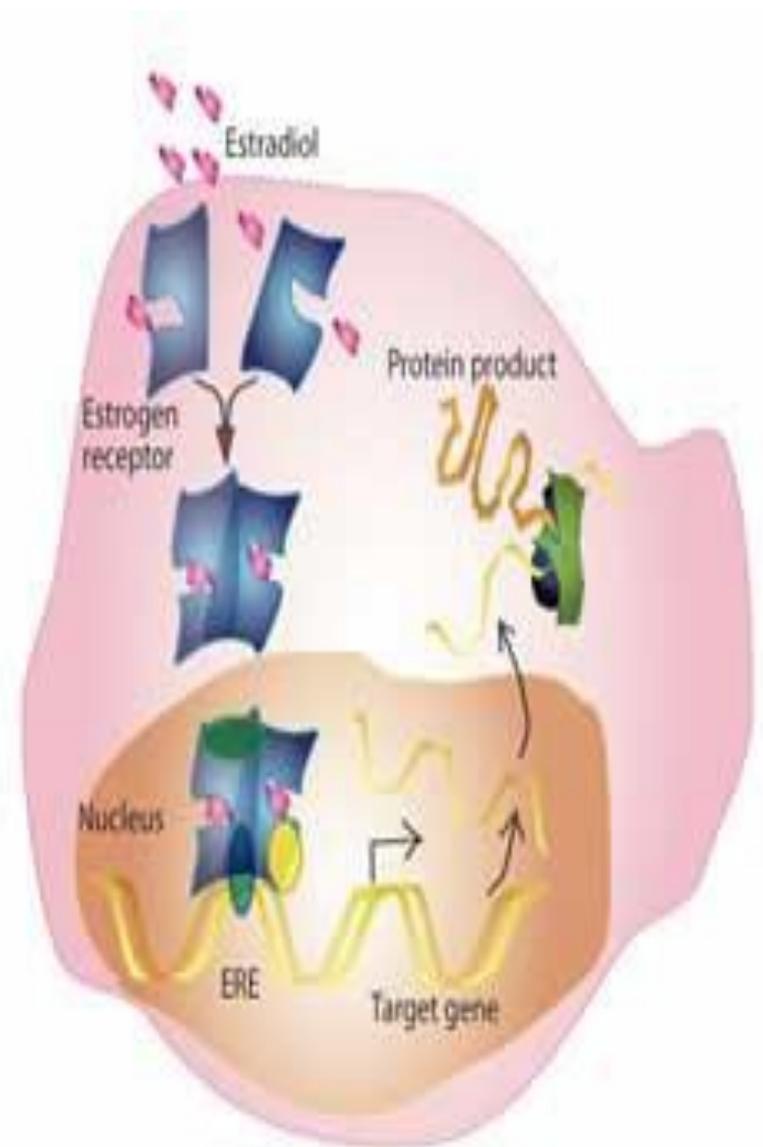
Risk of developing osteoporosis depends on how much bone mass attained between ages 25 and 35 (peak bone mass) and how rapidly it is lost later.

The higher peak bone mass , the more amount of bone "in the bone bank" and its less likely to develop osteoporosis as the person ages.

Not getting enough vitamin D and calcium in the diet may lead to a lower peak bone mass and accelerated bone loss later.

- **ESTROGEN AND BONE PROTECTION**

Estrogen is essential for healthy bone, When production of estrogen reduces, as occurs normally in postmenopausal women and pathologically after exposure to radiation or chemotherapeutic drugs, bones become brittle and break easily. However, the mechanisms involved aren't clearly understood.



- Currently, there is no accurate measure of global bone strength.
- **Bone mineral density (BMD)** is - an estimate measure for bone strength while it only accounts for 70% of bone strength.
- BMD results are represented as **T-scores** (matched with the BMD of young adult) **and Z-scores** (age and sex matched).
- The criteria developed by the National Osteoporosis Foundation and World Health Organization are as follows :

# WHO definitions based on bone mineral density levels (T score)\*

- **Normal**

BMD is within **+1 or -1 SD** of the young adult mean

- **Osteopenia (low bone mass)**

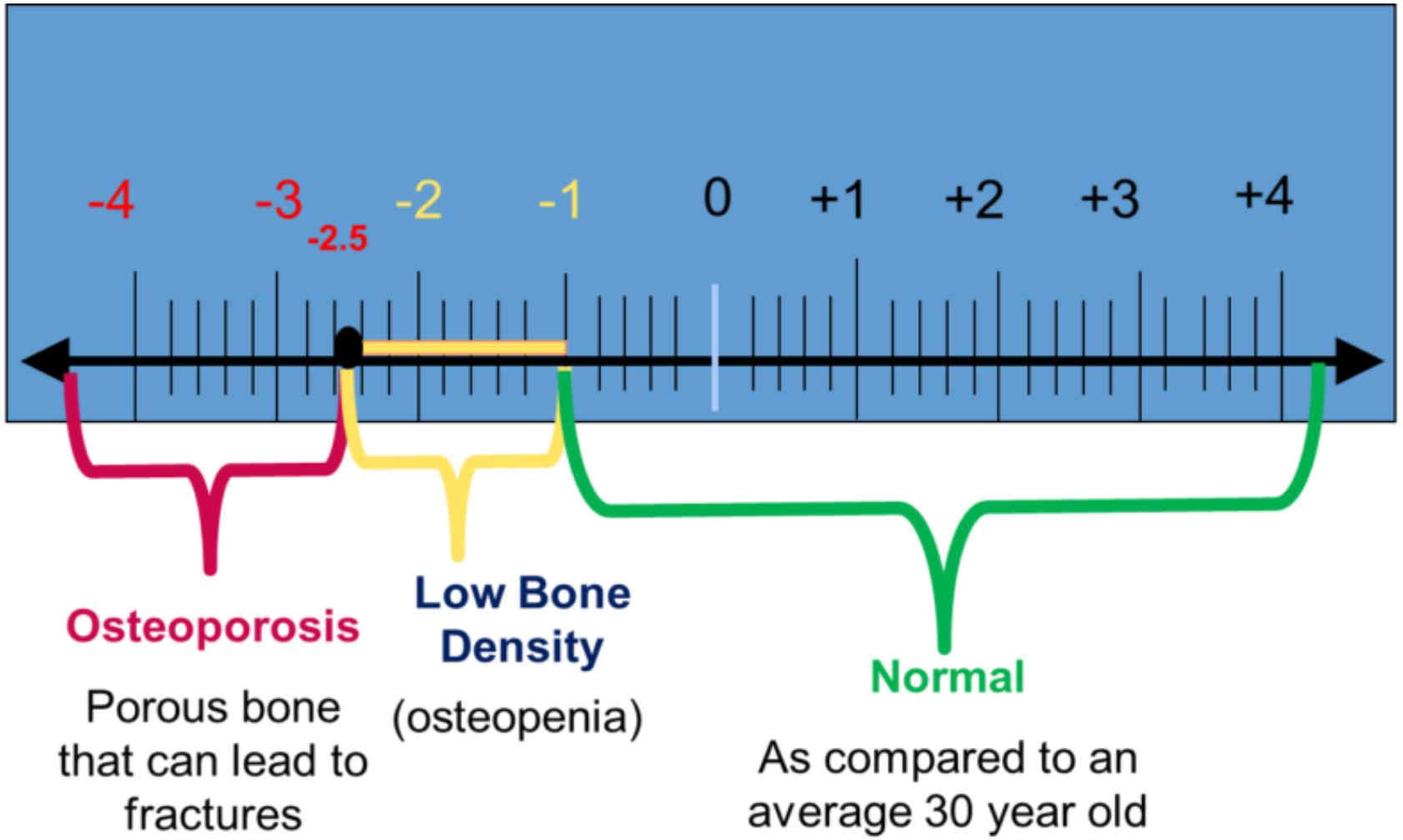
BMD is between **-1 and -2.5 SD** below the young adult mean

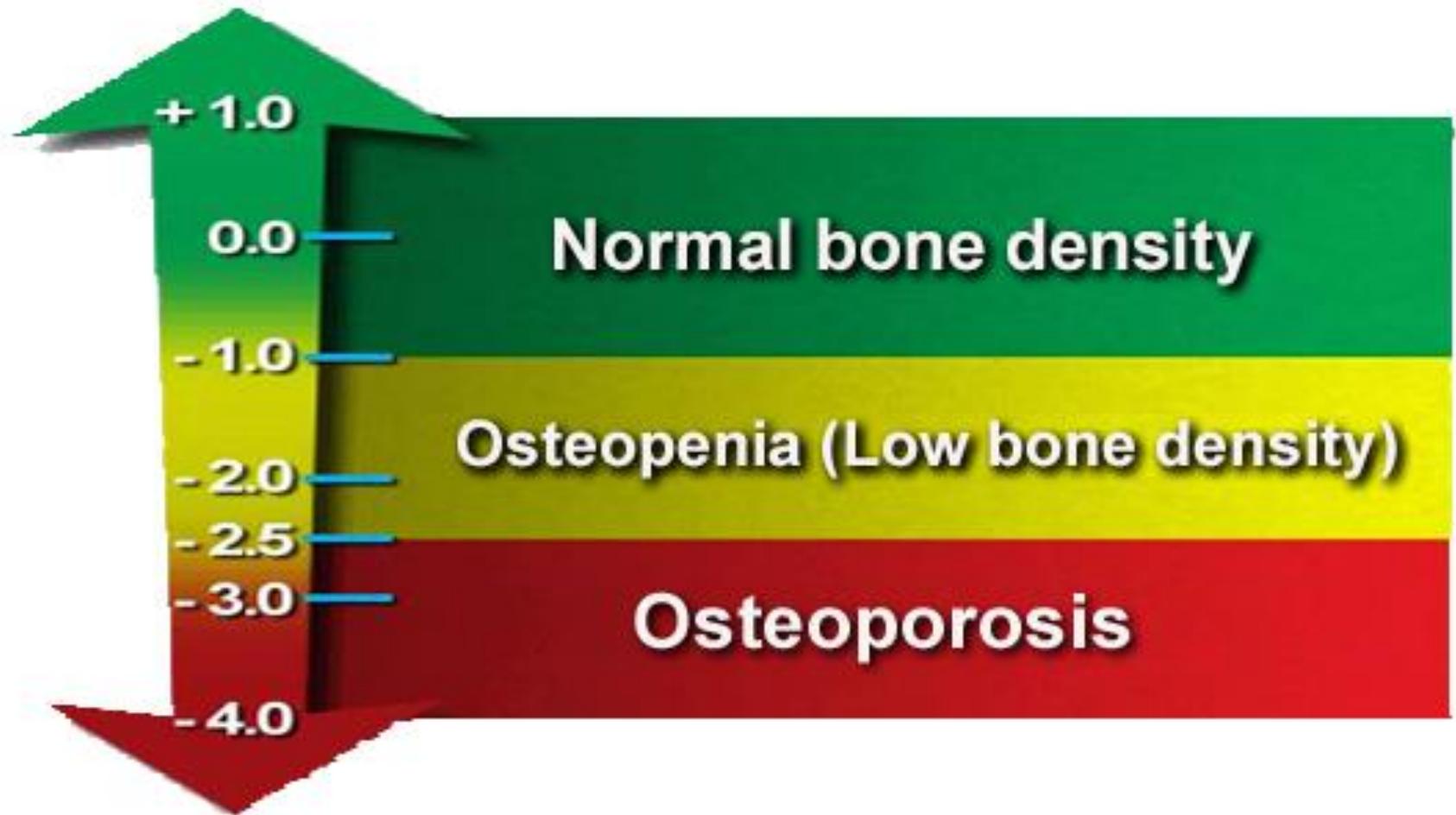
- **Osteoporosis**

BMD is **-2.5 SD or more** from the young adult mean

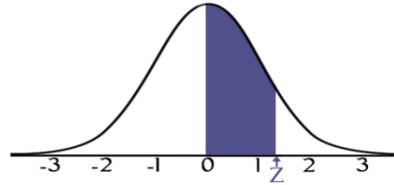
- **Severe (established) osteoporosis**

BMD is more than -2.5 SD and one or more osteoporotic fractures have occurred \*based on DXA measurement at hip, spine





# Z score chart

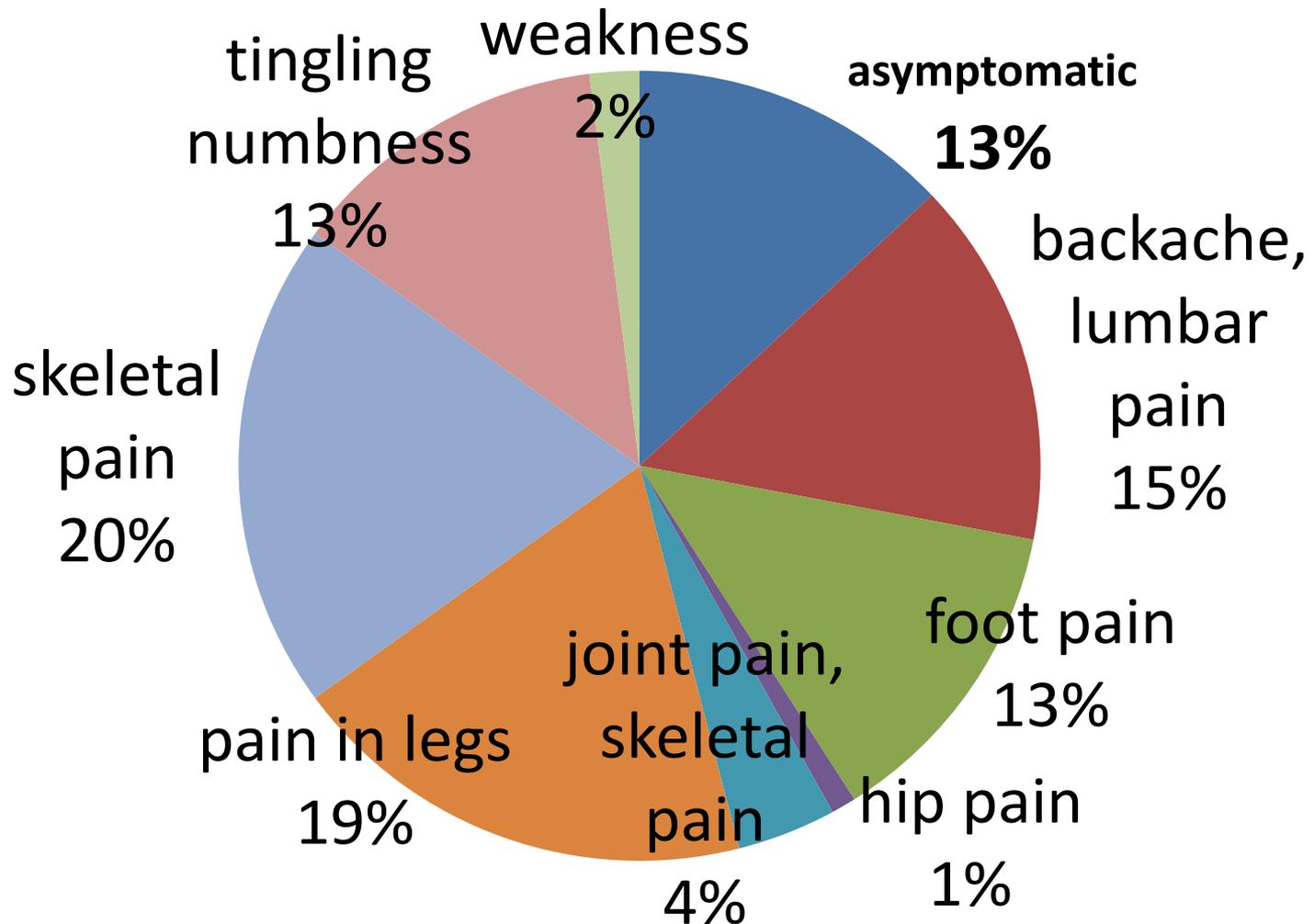


**STANDARD NORMAL TABLE (Z)**

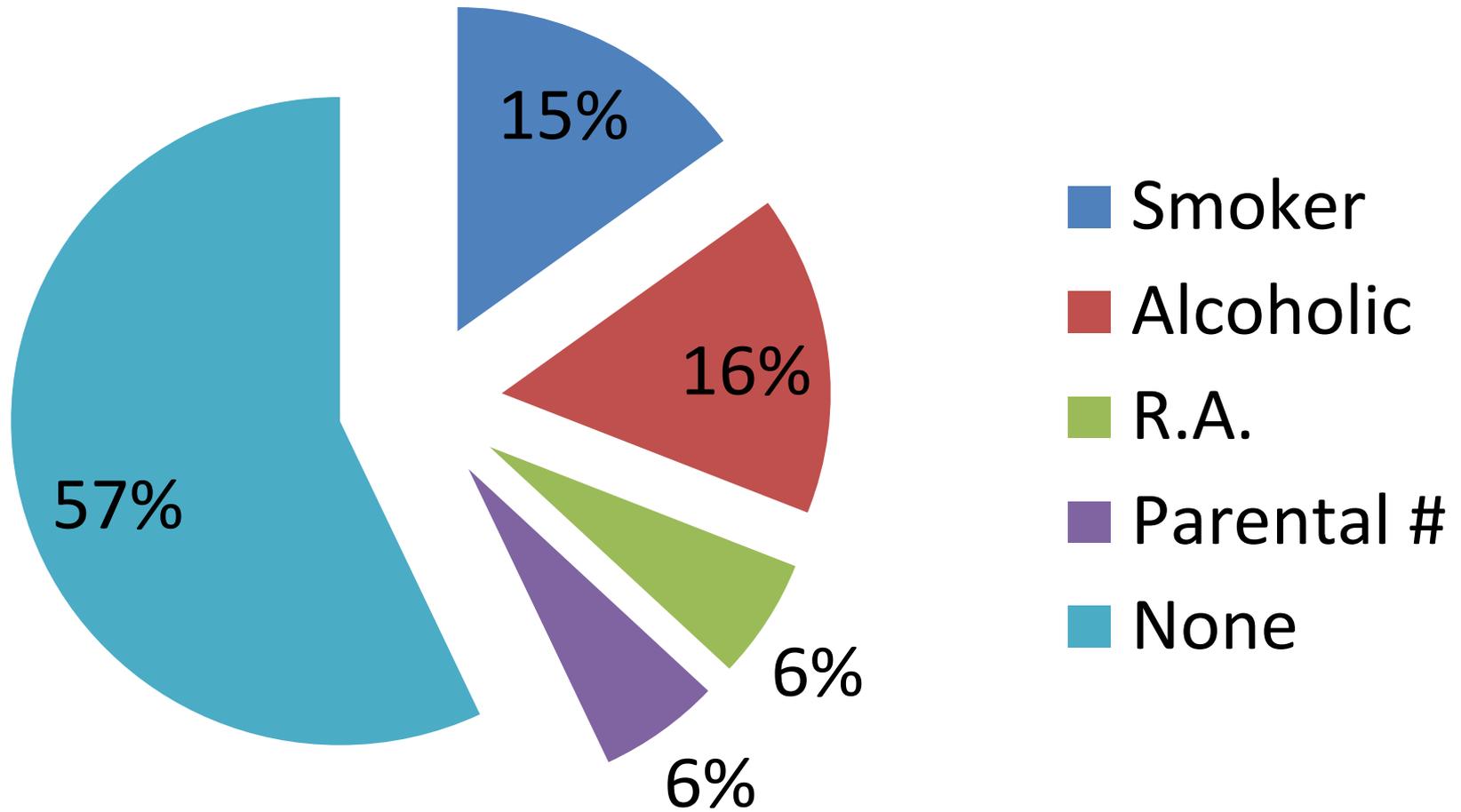
Entries in the table give the area under the curve between the mean and  $z$  standard deviations above the mean. For example, for  $z = 1.25$  the area under the curve between the mean (0) and  $z$  is 0.3944.

<b>Z</b>	<b>0.00</b>	<b>0.01</b>	<b>0.02</b>	<b>0.03</b>	<b>0.04</b>	<b>0.05</b>	<b>0.06</b>	<b>0.07</b>	<b>0.08</b>	<b>0.09</b>
<b>0.0</b>	0.0000	0.0040	0.0080	0.0120	0.0160	0.0190	0.0239	0.0279	0.0319	0.0359
<b>0.1</b>	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
<b>0.2</b>	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
<b>0.3</b>	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
<b>0.4</b>	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
<b>0.5</b>	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
<b>0.6</b>	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
<b>0.7</b>	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
<b>0.8</b>	0.2881	0.2910	0.2939	0.2969	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
<b>0.9</b>	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
<b>1.0</b>	0.3413	0.3438	0.3461	0.3485	0.3508	0.3513	0.3554	0.3577	0.3529	0.3621
<b>1.1</b>	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
<b>1.2</b>	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
<b>1.3</b>	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
<b>1.4</b>	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
<b>1.5</b>	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
<b>1.6</b>	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
<b>1.7</b>	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
<b>1.8</b>	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
<b>1.9</b>	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
<b>2.0</b>	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
<b>2.1</b>	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
<b>2.2</b>	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
<b>2.3</b>	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
<b>2.4</b>	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
<b>2.5</b>	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
<b>2.6</b>	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
<b>2.7</b>	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
<b>2.8</b>	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
<b>2.9</b>	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
<b>3.0</b>	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
<b>3.1</b>	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
<b>3.2</b>	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
<b>3.3</b>	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
<b>3.4</b>	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998

# Graphical representation of patients with respect to clinical presentation



# Distribution of patients with respect to risk factors





I am not sleeping,  
I am thinking!

- **TESTS AND DIAGNOSIS**

Osteopenia refers to mild bone loss that isn't severe enough to be called osteoporosis, but that increases the risk of osteoporosis.

The best screening test is dual energy X-ray absorptiometry (DEXA) – measures the density of bones in the spine, hip and wrist and it's used to accurately follow changes in these bones over time.

Ultrasound - Quantitative (QUS)

Quantitative CT scanning

**Dual energy X-ray absorptiometry**

- **Testing ....**

Older than age 65, regardless of risk factors.

Postmenopausal and have at least one risk factor for osteoporosis, including having fractured a bone.

Having vertebral abnormality.

Use of medications, such as prednisone, that can cause osteoporosis.

Type 1 diabetes, liver disease, kidney disease, thyroid disease or a family history of osteoporosis.

Experienced early menopause.

## Equipment for BMD Tests

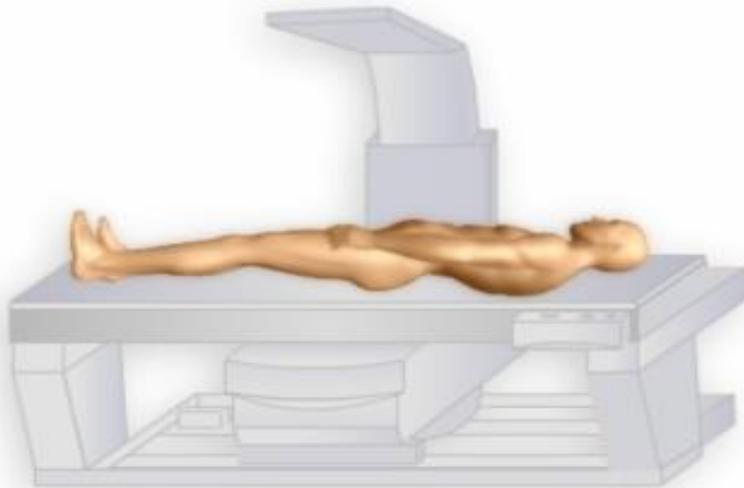
Bone Mineral Density Test:

- Measures calcium and other types of minerals present in an area of bone

Dual-energy x-ray absorptiometry (DEXA) scans are the most accurate and common method used.

- DEXA scans use low dose x-rays, less than what is used for dental scans

**Central Devices (large devices)**



**Central Device (DEXA)**

**Peripheral Devices (smaller devices)**



**Peripheral Device (Heel QUS)**

# Central DEXA– for hips and spine



# Peripheral DEXA (fingers, wrist, heel )



- Peripheral DEXA technology is portable and less expensive. It can be used as the diagnostic tool when central DEXA is not available.
- In recently published Indian study peripheral DEXA had high sensitivity (88%) but average specificity (55%). The high negative predictive value makes it useful tool in population screening for osteoporosis.
- However, peripheral DEXA is less useful in predicting the risk of fractures than central (spinal and hip) DEXA measurements.

- A bone mineral density (BMD) test measures how much calcium and other types of minerals are present in a section of your bone.

$$\text{Average bone mineral density} = \text{BMC} / W \text{ [g/cm}^2\text{]}$$

- BMC = bone mineral content = g/cm
- W = width at the scanned line

The health care provider uses this test, along with other risk factors, to predict your risk of bone fractures in the future and detect osteoporosis.

Bone fracture risk is highest in people with osteoporosis.

# COMPLICATIONS /Common fractures in the elderly

Fractures are the most frequent and serious complication of osteoporosis.

Often occurs in spine or hips – bones that directly support your weight.

- **Hip fractures and wrist fractures** from falls are common.
- **Compression fractures** can cause severe pain and require a long recovery. If many such fractures, can lose several inches of height as the posture becomes stooped.

## National Osteoporosis Foundation Guidelines

- ▶ Counsel all women on risk factors for osteoporosis
- ▶ Perform BMD tests for all postmenopausal women with fractures
- ▶ Recommend BMD for:
  - postmenopausal women <65 years with 1 or more risk factors
  - all women >65 years

## National Osteoporosis Foundation Guidelines Treatment/Prevention

- ▶ Calcium intake 1200 mg/day
- ▶ Vitamin D 400-800 IU/day for high-risk patients
- ▶ Regular weight-bearing, muscle-strengthening exercise
- ▶ Avoid smoking; moderate alcohol consumption
- ▶ Treat all vertebral and hip fracture cases
- ▶ Consider prophylactic treatment if:
  - T-score below  $-2.0$
  - T-score below  $-1.5$  with risk factors
- ▶ HRT is first-line therapy

## • TREATMENTS AND DRUGS

Hormone therapy (HT)

Prescription medications – Bisphosphonates,  
Raloxifene (Evista) / selective estrogen  
receptor modulators (SERMs) Tamoxifen, Calcitonin,  
Teriparatide (Forteo), Denosumab.

Doses:

Alendronate -35-70 mg per week on empty  
stomach, 1/2hr upright

Teriparatide – 20 mcg/day SC daily OD dose (thighs)

Calcitonin – 1 Spray nasal per day of 200 IU

Denosumab – 6 monthly SC injection

## **What keeps bones healthy**

Regular exercise

Adequate amounts of calcium

Adequate amounts of vitamin D, which is very essential for absorbing calcium

- **PREVENTION of Osteoporosis -**

Do exercise such as walking, running, skipping rope, jogging regularly.

Add Soy in diet – plant estrogens found in soy helps to maintain bone density and reduce the risk of fractures.

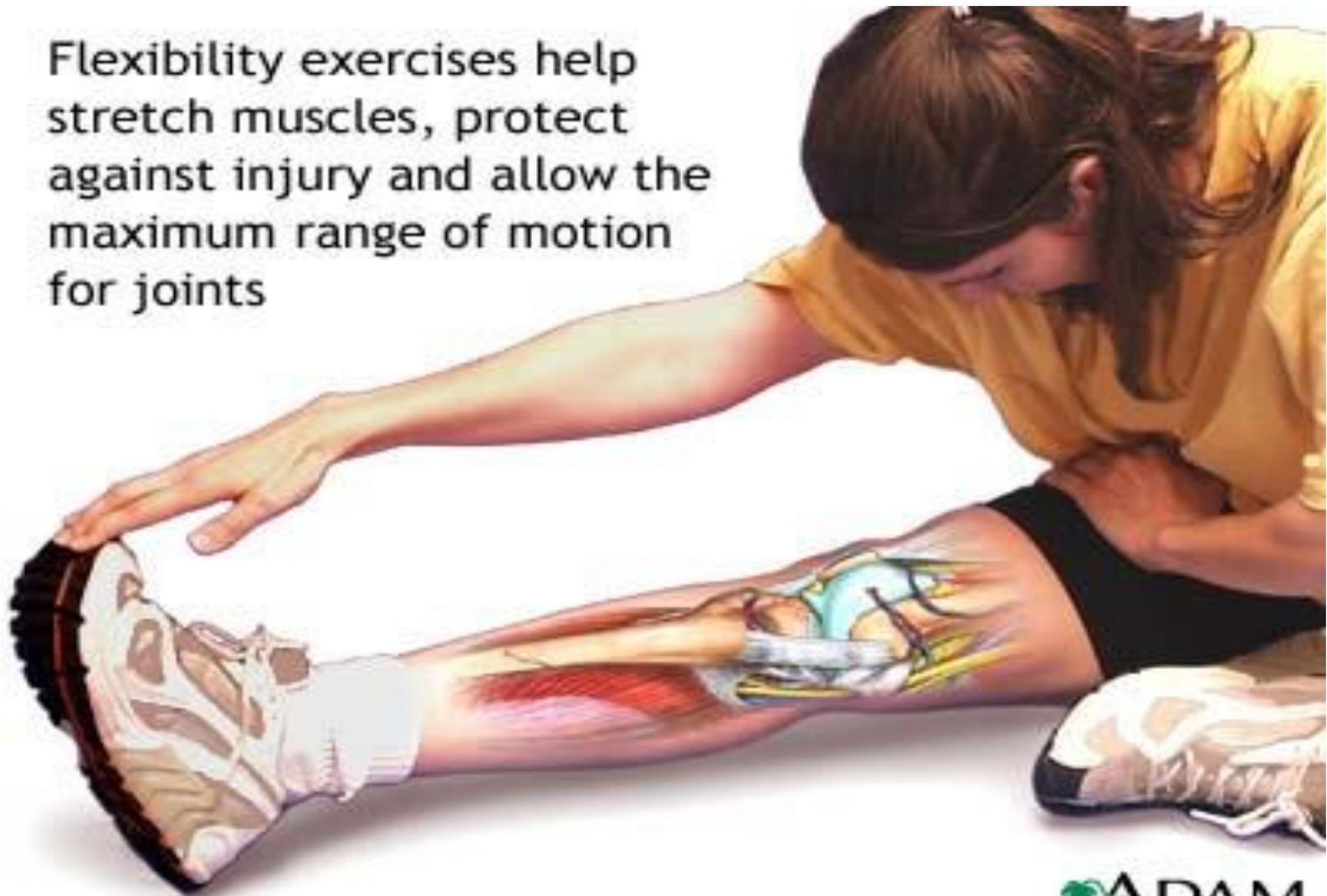
Avoid smoking, it can reduce the levels of oestrogen in females and increase bone's loss.

Avoid excessive alcohol.

Avoid caffeine, which is very harmful.

Consider hormone therapy.

Flexibility exercises help stretch muscles, protect against injury and allow the maximum range of motion for joints



 ADAM.

- **LIFESTYLE AND HOME REMEDIES**

Maintain **good posture** – Good posture which involves keeping the head held high, chin in, shoulders back, upper back flat and lower spine arched – helps avoid stress on spine.

When sitting or driving, place a rolled towel in the small sacral space of the back. Don't lean over while reading or doing handwork.

When lifting, bend at the knees, not the waist, and lift with the legs, keeping the upper back straight.

**Prevent falls.**

**Manage pain.** Don't ignore chronic pain.

# Exercise contraindications

- Dynamic abdominal exercises like sit-ups and excessive trunk flexion can cause vertebral crush fractures.
- Twisting movements such as a golf swing can also cause fractures
- Exercises that involve abrupt or explosive loading, or high-impact loading, are contraindicated.
- If you participate in Yoga or Pilates inform the instructor so that positions can be modified

- **SPECIFIC YOGA PRACTICE**
- Vriksha-asana
- Trikona-asana
- Virabhadra-asana
- Parvatakon-asana
- Bhujangasana
- Setu Bandhasana
- Shalabhasana
- Pavanmuktasana
- Ardha Matsyendrasana
- Jathara Parivartanasana

# Yoga postures



Tadasana



Vrksasana



Utthita  
Trikonasana



Utthita  
Parsvakonasana



Virabhadrasana II



Prasarita  
Padottanasana



Uttanasana



Adho Mukha  
Svanasana



Baddha Konasana



Virasana



Dandasana



Janusirsasana



Paschimottasana



Upavista  
Konasana



Bharadvajasana



Setubandha  
Sarvangasana



Viparita  
Karani



Savasana

# BENEFITS OF YOGA



THIN BODY



VITALITY



HEALTHY  
SPINE



CONCENTRATION



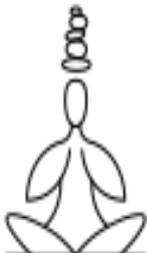
DEVELOP  
INTUITION



MEANING  
OF LIFE



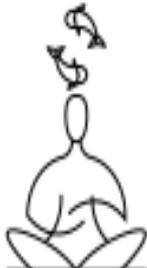
CURE  
DISEASES



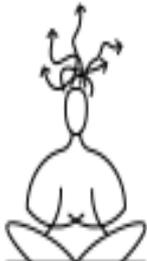
MENTAL  
BALLAST



DEEP  
RELAXATION



FIND  
HARMONY



UNDERSTAND  
YOURSELF



HAPPINESS

# Sun salutation poses in Yoga



# Burden of Osteoporosis

According to various surveys, worldwide 1 in 3 women >50 will suffer a fragility fracture; this increases to 1 in 2 in women > 60.

1 in 5 men >50 will suffer a fracture due to osteoporosis; this increases to 1 in 3 >60.

Approximately 1.6 million hip fractures occur each year worldwide and the incidence is set to increase to 6.3 million by 2050 currently .

There is an increasing incidence of hip fractures in the developed cities in Asia.

1 out of 4 hip fractures - in Asia and Latin America.

# Audience Q 1

- Which two substances mainly get reabsorbed by the body as we age which makes bone tissue weaker and leads to osteoporosis?
- b) Calcium and phosphorus
- c) Calcium and potassium
- d) Calcium and sodium
- e) Calcium and iron

## Q 2

- Why is the neurological part of the systems review important for patients with osteoporosis?
- b) Sensation is a major concern
- c) Want to know their ability to balance to prevent falls
- d) They have problems with motor learning
- e) Concerned with motor control

## Q 3

- Which is the most common and most accurate way to determine Bone Mineral Density testing :
- a) Densitometry scale
- b) Spine CT
- c) Dual-energy x-ray absorptiometry
- d) X-ray



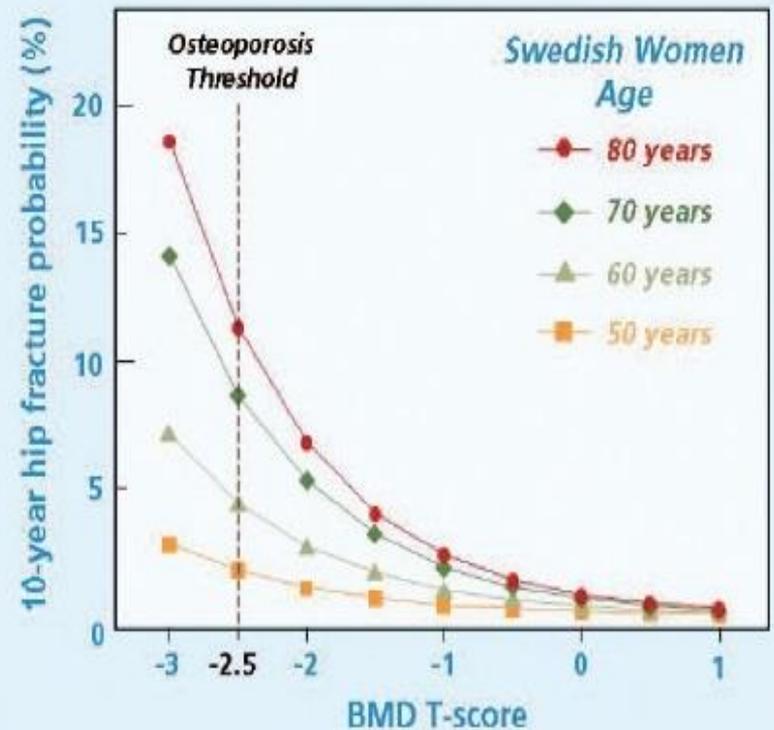
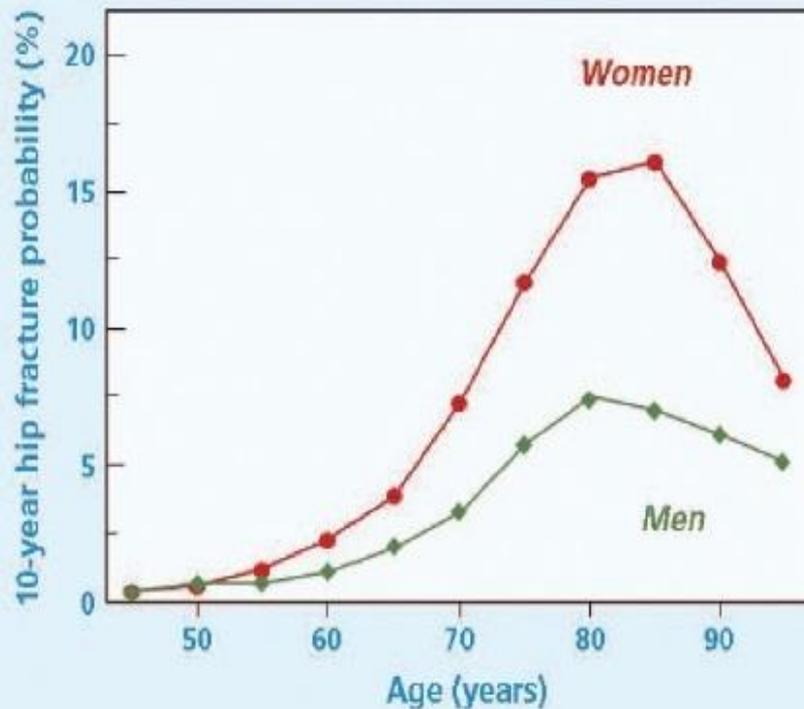
Thank  
You!

- A new study observed that one way estradiol helps to maintain bone density is by stopping the activation of an enzyme known as caspase-3.
- Also called the executioner caspase, caspase-3 is the central player in initiating the process of apoptosis, or programmed cell death of osteoblasts, the bone cells that aid in the growth and development of new bone and teeth.

Figure 4

## Fracture probability is age, BMD and gender specific

Instead of applying the same relative risk for a decrease in BMD across all ages, the FRAX<sup>®</sup> tool allows a more individualised calculation to be made that takes account of the BMD and its interaction with age.

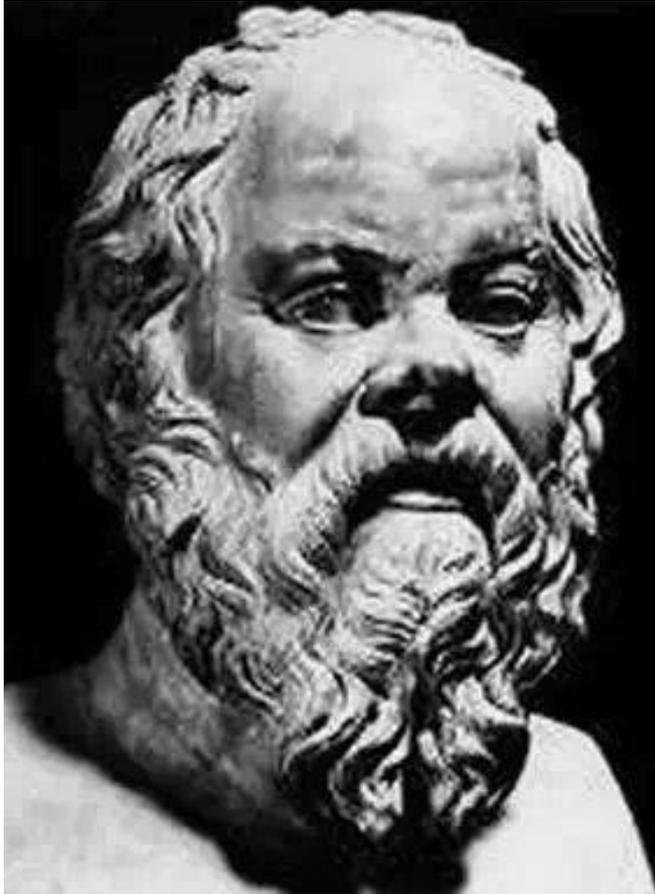


- **Normal** is a T-score of **-1.0 or higher** whose bone density is within 1 SD (-1 or +1) of the young adult .
- **Osteopenia** is defined by low bone mass whose bone density is **between 1.0 and 2.5 SD** below the young adult men (-1 to -2.5 SD).
- **Osteoporosis** is defined as **-2.5 or lower**, meaning a bone density that is two and a half standard deviations below the mean of a 30-year-old man/woman.
- **Severe (established) osteoporosis:** Bone density is **still more than 2.5 SD / less than 2.5 score** below young adult mean, **+\_one /more fractures**.

# FRAX<sup>®</sup> in the clinical setting

- The risk of fracture determined by FRAX<sup>®</sup> -
- If the risk of fracture is low, lifestyle advice about diet and exercise is given but medication is not required.
- If the risk is high then the clinician would likely recommend treatment.
- If the risk is intermediate, then a DXA scan is done. The FRAX<sup>®</sup> risk is recalculated and the decision made on whether medication is needed.
- Women with already a fracture after the menopause may be offered treatment without the need to calculate their risk.

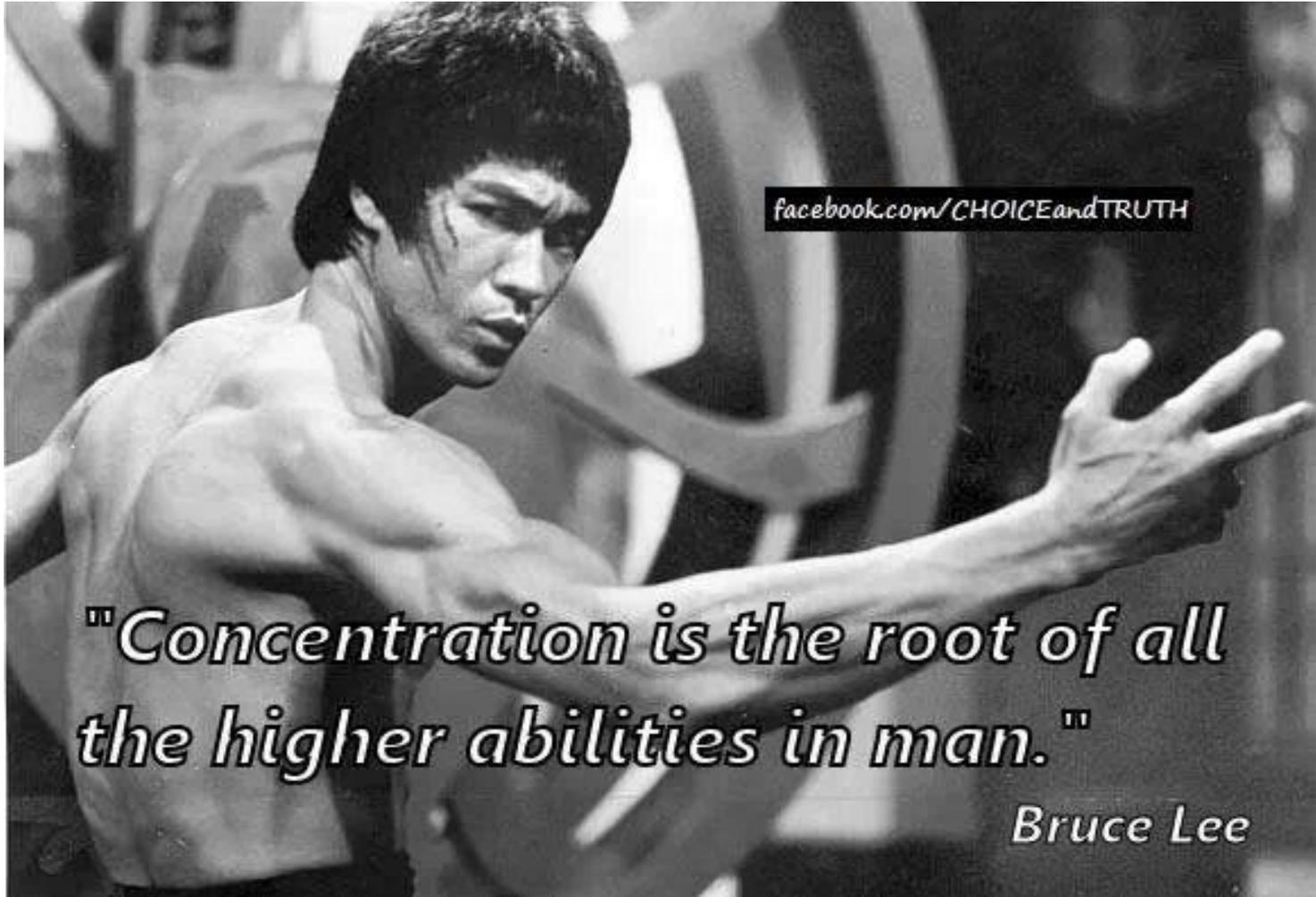
- ❖ Reaches the peak bone mass in mid-30s. After that, bone remodeling continues, but loss is slightly more than gain.
- ❖ At menopause/other conditions like ovarian failure , when oestrogen levels drop, bone loss increases dramatically.
- ❖ Many factors contribute to bone loss, the leading cause in women is decreased oestrogen production during menopause.



I CANNOT TEACH  
ANYBODY ANYTHING  
I CAN ONLY MAKE  
THEM THINK.

*Socrates*

CHOICEandTRUTH



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*"Concentration is the root of all the higher abilities in man."*

*Bruce Lee*



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**Evaluation of Osteoporosis in Elderly with Novel Diagnostic Tools**

Authors

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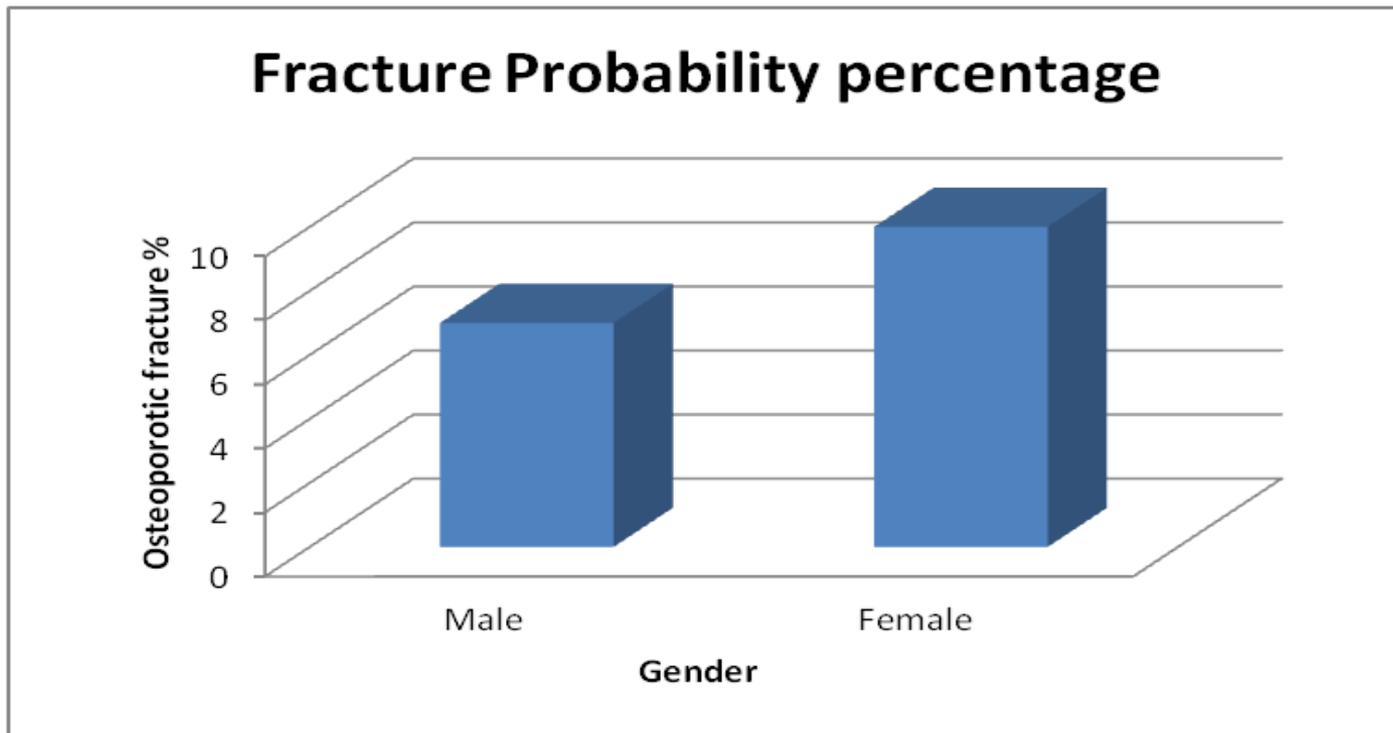
**ABSTRACT**

*Introduction: The morbidity of osteoporosis is under recognized as well as less studied. It is a current world*

# Information required to calculate FRAX

- **Country**
- **bone mineral density**
- **age**
- **gender**
- **clinical risk factors**
  - - **low body mass index**
  - - **previous fragility fracture**
  - - **parental history of hip fracture**
  - - **glucocorticoid treatment**
  - - **current smoking**
  - - **alcohol intake (3 or more units per day)**
  - - **rheumatoid arthritis**
  - - **other secondary causes of osteoporosis**

# Gender distribution of fracture probability percentage in 10 years.



# FRAX<sup>®</sup> calculation tool - UK

Country : **UK**      Name / ID :       [About the risk factors](#) ⓘ

### Questionnaire:

1. Age (between 40-90 years) or Date of birth  
Age:       Date of birth: Y:  M:  D:

2. Sex       Male       Female

3. Weight (kg)     

4. Height (cm)     

5. Previous fracture       No       Yes

6. Parent fractured hip       No       Yes

7. Current smoking       No       Yes

8. Glucocorticoids       No       Yes

9. Rheumatoid arthritis       No       Yes

10. Secondary osteoporosis       No       Yes

11. Alcohol 3 or more units per day       No       Yes

12. Femoral neck BMD (g/cm<sup>2</sup>)

**BMI 23.9** 

**The ten year probability of fracture (%)**

**without BMD**

■ Major osteoporotic	<b>9.5</b>
■ Hip fracture	<b>1.5</b>

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# THANK YOU for patient listening !

Talent hits a target no  
one else can hit; Genius  
hits a target no one  
else can see.

Arthur Schopenhauer

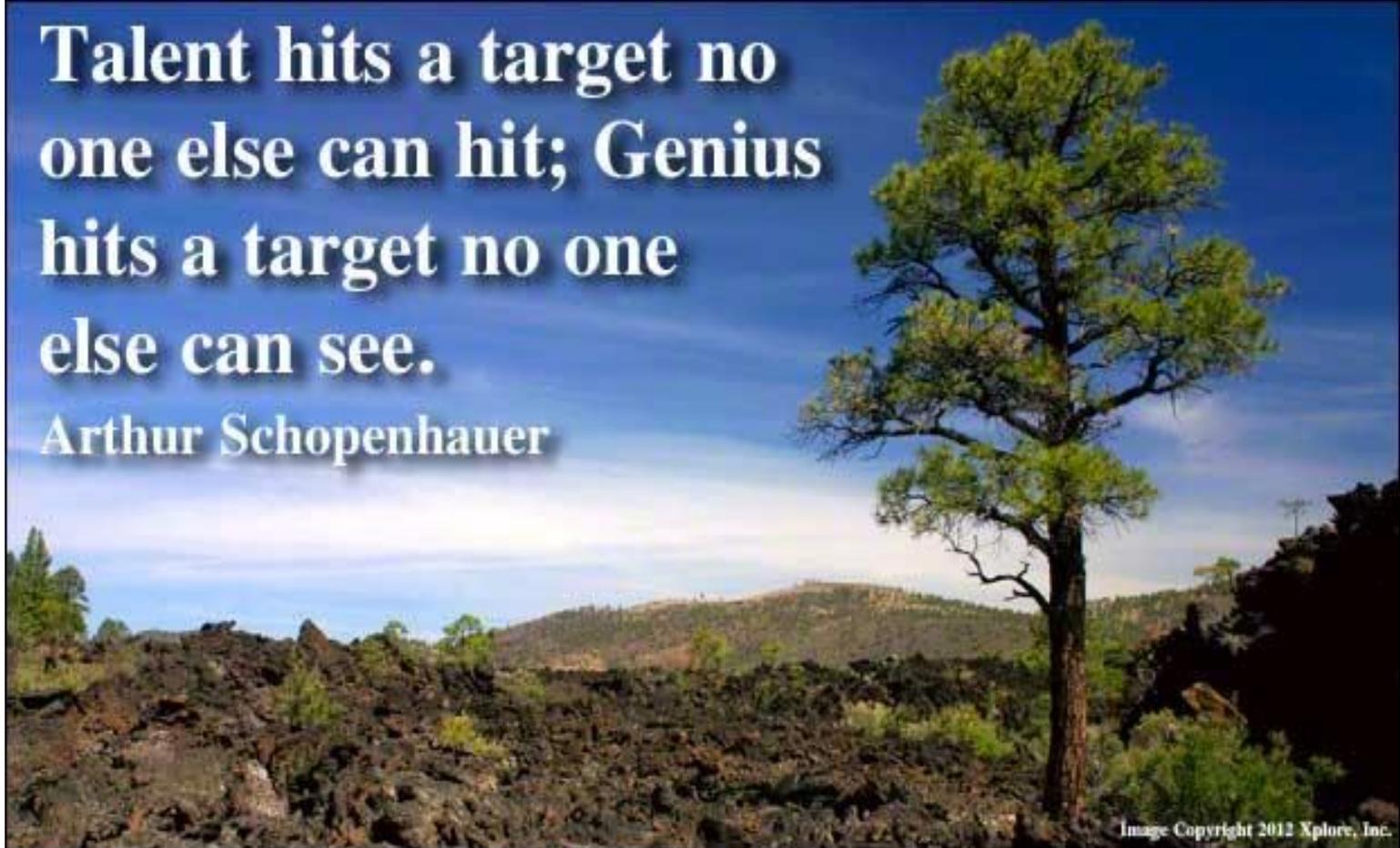
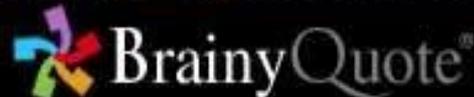


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# Key findings of the study -

- Age, BMI, postmenopausal state, nutritional habits, smoking, alcohol, corticosteroids use - influencing and interacting factors.
- The prevalence of osteoporosis - proportional to the age and calcium levels as independent predictors.
- There is a vast majority of patients of osteoporosis than osteopenia.
- 50% osteoporotic patients have obvious secondary risk factors
- Peripheral DEXA can be used to assess osteoporosis and in turn overall risk of fractures.

- The high negative predictive value makes it useful tool for screening in population for osteoporosis.
- Also, FRAX score diagnoses at risk osteoporotic population.
- The two tools namely Peripheral DEXA and FRAX score are useful in resource limited settings and it can also be used in clinical decision making for treatment of osteoporosis.

- *Fracture risk assessment score : FRAX score :*
- It is a diagnostic tool to assess the 10 year probability of bone fracture risk.
- It can be calculated with or without femoral neck BMD.
- The input for this software is individual patient details comprising of age (50 to 90 years), sex, weight (in kg) and height (cm), country (index or surrogate).

- Bone mineral density (BMD) data is optional  
The software then gives an absolute fracture risk for 10 years.
- The current Osteoporosis Foundation guide recommends **treating** patients with FRAX 10 year risk score of **> or =3%** for hip fracture or **> or =20%** for major osteoporotic fracture, to reduce fracture risk.
- FRAX is country specific.

It's not  
the load  
that breaks  
you down,  
it's the  
way you  
carry it.

- Lena Horne

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