

Role of Nutrition in Osteoporosis

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ABSTRACT

Osteoporosis is a systemic skeletal disorder characterized by low bone mass and microarchitectural deterioration of bone tissue, leading to increased bone fragility and fracture risk. It is a major public health concern, particularly among postmenopausal women and the elderly. This review discusses the pathophysiology, risk factors, diagnosis, and management strategies for osteoporosis.

KEY WORDS: Osteoporosis, Nutrition, Prevention

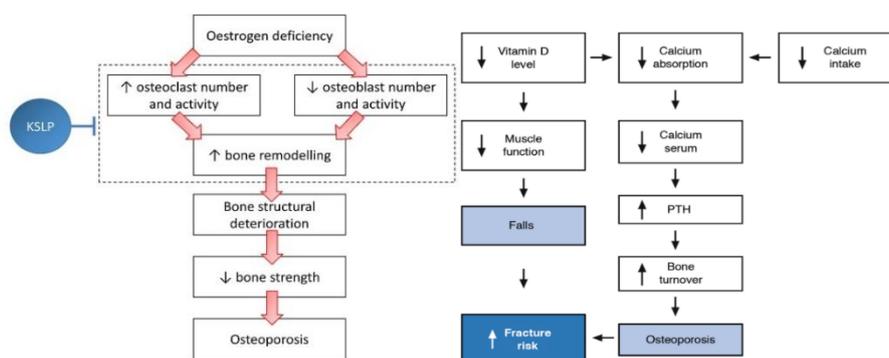
INTRODUCTION:

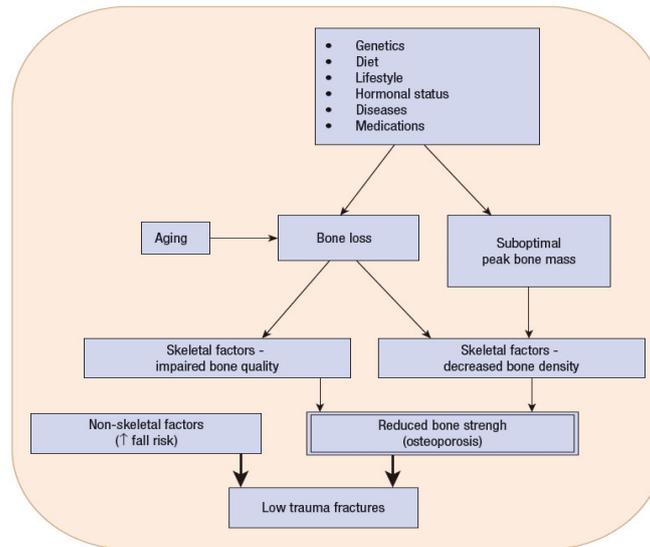
Osteoporosis is a skeletal disorder characterized by compromised bone strength predisposing individuals to an increased fracture risk. [1,13] The condition affects millions worldwide, contributing to significant morbidity, mortality, and healthcare costs. Osteoporosis is estimated to affect 200 million women - approximately one-tenth of women aged 60, one-fifth of women aged 70, two-fifths of women aged 80 and two-thirds of women aged 90. Personal risk by postmenopausal women, lack of dialogue about osteoporosis with their doctor, and restricted access to diagnosis and treatment before the first fracture result in under-diagnosis and undertreatment of the disease. Furthermore, the ageing of populations across the globe will be responsible for a major increase in the incidence of osteoporosis in postmenopausal women. [2]

PATHOPHYSIOLOGY

Bone remodeling is a dynamic process involving bone resorption by osteoclasts and bone formation by osteoblasts. Osteoporosis results from an imbalance in this process, where resorption exceeds formation, leading to weakened bone structure. Several factors contribute to this imbalance, including hormonal changes, nutritional deficiencies, and genetic predisposition.

- **Hormonal Factors:** Estrogen deficiency post-menopause accelerates bone loss.
- **Calcium and Vitamin D Deficiency:** Essential nutrients for bone mineralization.
- **Genetic and Lifestyle Factors:** Family history, smoking, alcohol consumption, and physical inactivity contribute to risk. [3,4,5,6]





RISK FACTORS

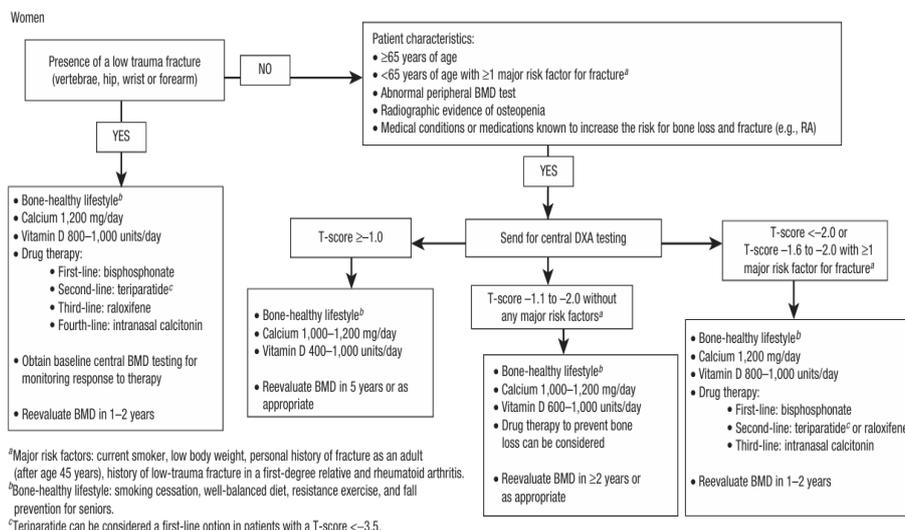
Several modifiable and non-modifiable risk factors influence osteoporosis development:

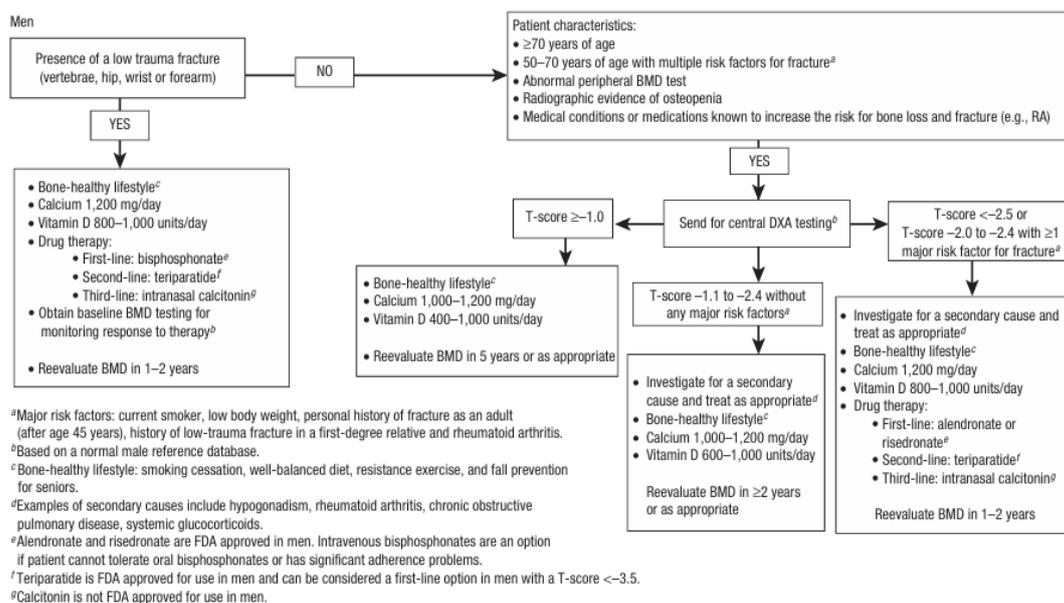
- **Non-Modifiable:** Age, gender, genetics, and ethnicity.
- **Modifiable:** Diet, physical activity, smoking, and alcohol use.
- **Medical Conditions:** Rheumatoid arthritis, hyperthyroidism, and chronic kidney disease.^[7,8]

DIAGNOSIS

Osteoporosis is diagnosed primarily through

1. Bone mineral density (BMD) testing using dual-energy X-ray absorptiometry (DXA). The World Health Organization (WHO) defines osteoporosis as a BMD T-score of -2.5 or lower.
2. Other diagnostic tools include:
 - **Biochemical Markers:** Assess bone turnover rates.
 - **Fracture Risk Assessment Tool (FRAX):** Estimates the 10-year probability of fractures.^[9]





MANAGEMENT AND TREATMENT

Management of osteoporosis involves lifestyle modifications, pharmacological treatment, and fall prevention strategies.

Lifestyle Modifications

- **Diet:** Adequate intake of calcium (1000–1200 mg/day) and vitamin D (800–1000 IU/day).
- **Exercise:** Weight-bearing and resistance exercises improve bone strength.
- **Avoidance of Risk Factors:** Smoking cessation and alcohol moderation.^[10]

Group and Ages	Institute of Medicine Adequate Intake	
	Elemental Calcium (mg) ^a	Vitamin D (units) ^{a,b}
Infants		
Birth to 6 months	210	200
6–12 months	270	200
Children		
1–3 years	500	200
4–8 years	800	200
9–13 years	1,300	200
Adolescents		
14–18 years	1,300	200
Adults		
19–50 years	1,000	200
51–70 years	1,200	400
>70 years	1,200	600

Food	Serving Size	Calcium Content (mg)	Vitamin D Content (units)
Milk	1 cup	300	100
Powdered nonfat milk	1 teaspoon	50	—
Ice cream	1 cup	200	—
Yogurt, fortified	1 cup	240–415	60
American cheese	1 oz	150	—
Cheddar cheese	1 oz	211	—
Cottage cheese	1/2 cup	100	—
Swiss cheese	1 oz	250	—
Parmesan cheese	1 tablespoonful	70	—
Cheese pizza	1 slice	150	—
Macaroni and cheese	1 cup	360	—
Slim Fast	11 oz	400	140
Orange juice, fortified	1 cup	350	100
Soy milk, fortified	1 cup	80–300	100
Bread, fortified	1 slice	100	—
Cereals, fortified	1 cup	100–250	60
Sardines with bones	3 oz	370	230
Salmon with bones	3 oz	170–210	310
Catfish	3 oz	—	570
Halibut	3 oz	—	680
Tuna	4 oz	—	260
Almonds	1 oz	80	—
Bok choy	1/2 cup	125	—
Broccoli	1 cup	130–160	—
Collards	1/2 cup	180	—
Corn bread	1 slice	85	—
Egg, medium	1	55	25
Figs, dried	5 medium	125	—
Kale	1/2 cup	95	—
Orange	1	52	—
Soybeans	1 cup	130	—
Spinach	1/2 cup	110	—
Tofu	4 oz	140	—
Turnip greens	1/2 cup	125	—

Product (% calcium) ^a	Elemental Calcium (mg)	Vitamin D (units)
<i>Calcium carbonate (40%)^b</i>	—	—
Trade and generic products	200–600	100–200
Mylanta Supreme liquid (5 mL)	160	—
Tums Chewable	200	—
Tums E-X	300	—
Tums Ultra	400	—
Rolaids chewable	471	—
Os-Cal sugar-free chewable	500	400
Viactiv chews ^c	500	200
CalMax powder (10 mL)	400	—
Bayer's Women ^d	300	—
Ensure high calcium ^e (8 oz)	400	140
<i>Calcium citrate (24%)</i>	—	—
Generic	315	200
Citracal + Vit D	200–315	200
Citracal chew	500	200
<i>Tricalcium phosphate (39%)</i>	—	—
Posture-D	600	125
<i>Vitamin D₃ (cholecalciferol)</i>	0	400, 700, 800, or 1,000
<i>Ergocalciferol (D₂)^e</i>	—	—
Liquid (1 mL)	—	8,000
Tablets/capsules	—	25,000 or 50,000
Intramuscular	—	500,000

PHARMACOLOGICAL TREATMENT

1. **Bisphosphonates:** Alendronate, risedronate, and zoledronic acid inhibit bone resorption.
2. **Selective Estrogen Receptor Modulators (SERMs):** Raloxifene mimics estrogen's beneficial effects on bone.

3. **Denosumab:** A monoclonal antibody that inhibits osteoclast formation.
4. **Teriparatide:** A parathyroid hormone analog that stimulates bone formation.
5. **Romosozumab:** A newer therapy promoting bone formation and reducing resorption.
6. **Calcitonin:** Calcitonin is released from the thyroid gland when serum calcium is elevated.
7. **Testosterone:** Testosterone replacement is not FDA approved for the prevention or treatment of osteoporosis
8. **Thiazide Diuretics:** Thiazide diuretics increase urinary calcium reabsorption.^[11]

FALL PREVENTION

- **Home Safety Modifications:** Removing trip hazards, adequate lighting.
- **Physical Therapy:** Balance training and muscle strengthening.^[12]

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