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A COMPREHENSIVE REVIEW OF OSTEOPOROSIS-A DEMINERALIZING METABOLIC BONE DISEASE

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ABSTRACT

Osteoporosis is a common metabolic bone disease marked by reduced bone mass and microarchitectural deterioration, leading to fragility fractures and disability. It significantly impacts morbidity and healthcare costs worldwide. Conventional management includes medications, calcium/vitamin D supplementation, and lifestyle changes. Homoeopathy offers an individualized, cost-effective approach that may improve bone health, aid fracture healing, and reduce complications. This article reviews the causes, modern treatments, and homoeopathic management of osteoporosis.

KEYWORDS:

Bone, Bone Mineral Density, Bone Remodelling, Fragility, Fracture Risk, Homoeopathy, Osteoporosis, Postmenopausal Bone Loss

INTRODUCTION

Osteoporosis is a progressive bone disease characterised decreased bone mass and structural deterioration, increasing fracture risk, especially in the hip, spine, and wrist.

Known as a “silent” disease, it goes undetected until a fracture occurs. It primarily affects postmenopausal women and older men, particularly white and Asian individuals. The condition arises when bone resorption surpasses bone formation. Early diagnosis through bone density screening is essential for those with risk factors like ageing, prior fractures, or family history. Prevention includes medication, a diet rich in calcium and vitamin D, and regular weight-bearing exercise. [1][2]

METHODS

A thorough literature search was carried out using PubMed, focusing on general keywords such as osteoporosis, epidemiology, risk factors, pathophysiology, clinical manifestations, and its prevalence. Relevant articles were selected based on their titles and abstracts, with citation lists also reviewed to identify additional sources. This review is based solely on previously published research and does not include any studies conducted by the authors.

BACKGROUND

Osteoporosis is a, chronic bone disease characterized by decreased bone mass and weakened bone structure, increasing fracture risk. It affects postmenopausal women, the elderly, and people with smaller frames or of white or Asian descent but can impact anyone. Usually asymptomatic until fractures occur, early screening in at-risk individuals is crucial. The disease can cause chronic pain, disability, and loss of independence but is preventable and treatable. Management involves lifestyle changes like weight-bearing exercise, avoiding smoking and excessive alcohol, and ensuring adequate calcium and vitamin D and medications such as bisphosphonates, raloxifene, denosumab, and anabolic agents. Addressing secondary causes is also important to reduce long-term effects. (1)

EPIDEMIOLOGY

Osteoporosis affects over 200 million people globally, with risk increasing with age. Around 70% of those over 80 are affected. Women are at higher risk, with a 1 in 3 lifetime fracture risk for women and 1 in 5 for men over age 50. Approximately 9 million fractures occur worldwide each year due to osteoporosis. [2]

Fractures are most common in the hip, spine, and wrist, increasing with age: wrist fractures in the 50s, spine fractures in the 70s, and hip fractures in the 80s.[2] Postmenopausal women are at risk due to hormonal bone loss 50% will experience an osteoporosis-related fracture; 25% may develop spinal deformities, and 15% may have a hip fracture.[1]

Men are also affected, due to secondary causes such as low testosterone, heavy alcohol use, or long-term steroid therapy.(1)

Bone mineral density (BMD) testing assesses bone strength. A significant BMD drop can double or triple spine fracture risk. Even adults aged 35–50 can show early signs of bone thinning, more in men than women in that age group. (1)

Osteoporosis is more common in non-Hispanic white and Asian women, with Hispanic women showing a rapidly rising risk. Although Black individuals have lower rates, the disease is mostly underdiagnosed and undertreated across all groups. (1) Lower vitamin D levels, in regions far from the equator with less sunlight, also contribute to higher risk. (2) With global ageing, especially in Asia, Osteoporosis-related fractures are expected to rise significantly half of all hip fractures are projected to occur in Asia by mid-century. (1)

ETIOLOGY

Osteoporosis can be classified into two main types: primary and secondary. Primary osteoporosis is primarily associated with the natural ageing process and the decline in sex hormone levels, particularly estrogen in women and testosterone in men. As people age, their bones lose density and structural integrity, increasing the risk of fractures.(2)

Secondary osteoporosis, common in men, is caused by medical conditions or medications like glucocorticoids, antiepileptics, chemotherapy agents, Proton Pump Inhibitors, and thiazolidinediones, which can weaken bone health (2)

Several medical conditions like hyperparathyroidism, anorexia, malabsorption syndromes, hyperthyroidism, overtreatment of hypothyroidism, chronic kidney disease, Cushing's syndrome, and prolonged immobility due to illness or injury worsen osteoporosis. In women, secondary amenorrhea lasting more than an year, due to low body weight, excessive exercise, or hormone therapy, can cause rapid decrease in bone density.(2)

Multiple risk factors like older age, female sex, low body weight (under 128 pounds), smoking, excessive alcohol intake, family history of osteoporosis, early menopause, low physical activity levels, and a previous fracture from minimal trauma, after age 40. Individuals with mobility-impairing conditions, such as spinal cord injuries, can experience significant bone loss within just two weeks of immobility.(2) Osteoporosis is a multifactorial condition shaped by genetic, environmental, medical, and lifestyle factors. (2)

PATHOPHYSIOLOGY

When bone resorption exceeds bone formation either as a result of low peak bone mass or rapid bone loss osteoporosis results. Age-related imbalances in bone remodelling, which is necessary for bone strength, result in trabecular loss and cortical thinning, which make bones more brittle. (1)(2)(3)

Osteoclasts break down bone, while osteoblasts build new bone. Hormones like estrogen, PTH, and testosterone regulate this balance, with estrogen promoting formation and inhibiting resorption via receptors on osteoblasts. Local factors such as PGE2 and leukotrienes also affect remodeling. Mechanical stress and PTH lower sclerostin, a Wnt pathway inhibitor that suppresses osteoblasts; targeting sclerostin is a promising treatment. (3)

The RANK/RANKL signaling pathway is essential for osteoclast activation, while osteoprotegerin acts as a decoy receptor to inhibit RANKL. An imbalance here leads to bone loss. Additional pathways like ITAM (via DAP12 and FcRγ receptors) work with RANKL to fully activate osteoclasts, mediated by the NFATc1 transcription factor, a key regulator of bone resorption.(3) Understanding these molecular interactions is key to developing therapies for osteoporosis.

HISTOPATHOLOGY

Histologic samples show significantly thinned trabeculae, smaller osteons, and enlarged Haversian canals and marrow spaces.

RISK FACTORS

Uncontrollable Risk Factors

- Women are at a much higher risk of developing osteoporosis than men.
- Advancing age.
- Individuals of white or Asian descent.
- A family history of osteoporosis.
- People with short stature.

Hormonal Influences

- Low estrogen levels in women, after menopause.
- Reduced testosterone levels in men.
- Excess thyroid hormone, either an overactive thyroid or overmedication for an underactive thyroid, weakens the bone.
- Overactive parathyroid and adrenal glands.

Dietary Factors

- Calcium deficiency.
- Disorders like anorexia nervosa results in undernourishment and being underweight weaken bones in both sexes.
- Surgeries that reduce stomach size or remove parts of the intestine limit the body's ability to absorb essential nutrients.

Medications

- Long-term use of oral or injected steroids like prednisone or cortisone impairs the bone rebuilding.
- Drugs used for the conditions such as seizures, gastric reflux, cancer, and transplant rejection leads to bone loss.

Medical Conditions

- Celiac Disease
- Inflammatory Bowel Disease
- Kidney or Liver Disease
- Cancer
- Multiple Myeloma
- Rheumatoid Arthritis
- Lifestyle Choices
- Physical Inactivity.
- Excessive Alcohol, Tobacco usage.

CLINICAL MANIFESTATION:

Osteoporosis develops silently, with few noticeable symptoms in its early stages. Majority are unaware they have bone loss until they experience fracture, in the hip, wrist, or spine.

Early Signs of Osteoporosis:

- Receding gums. [6]
- Weakened grip strength. [6]
- Brittle fingernails. [6]

Later Symptoms of Osteoporosis:

- Loss of height due to Spinal compression. [6]

- Fractures from minor incidents. [6]
- Back or neck pain due to pinched nerves. [6]
- Kyphosis causing pain and difficult breathing. [6]

STAGES: [7]

Stage	Age/Description	Symptoms
Stage 1	Ages 20–40. Bone formation and breakdown are balanced; normal bone density.	No symptoms.
Stage 2	Bone loss begins to exceed formation. Osteopenia may be diagnosed.	Typically no symptoms.
Stage 3	Onset of osteoporosis.	Increased fracture risk from minor injuries; no visible symptoms.
Stage 4	Advanced osteoporosis.	Bone weakening, fractures, pain, hunched posture.

PROGNOSIS

When detected early and treated, osteoporosis has a good prognosis. Treatment with exercise, calcium-rich diets, and medications like bisphosphonates can reduce risk, though bisphosphonates are expensive, have side effects, and their effectiveness in preventing fractures is debated. [4] Untreated osteoporosis can lead to fractures, chronic pain, and loss of independence, especially in postmenopausal women, who face a high risk of hip fractures. Vertebral fractures may cause kyphosis, breathing issues, and increased pneumonia risk. [4]

COMPLICATIONS

Osteoporosis can lead to serious complications, primarily fractures of the hip and spine. Hip fractures, caused by falls, are associated with high rates of disability, infection, and mortality. Spinal compression fractures may occur with minimal stress, such as bending or coughing, and go undiagnosed. These fractures can cause chronic pain, height loss, kyphosis, and impaired lung function·(2). Multiple fractures lead to reduced mobility, increased risk of DVT, pressure ulcers, and a decline in quality of life. Spinal deformities and height loss may also impact self-esteem and increase the risk of depression(1)

DIAGNOSIS AND FRACTURE RISK ASSESSMENT

Osteoporosis is primarily diagnosed using bone densitometry, dual-energy X-ray absorptiometry (DEXA), which accurately measures bone mineral density (BMD).

Assessing fracture risk through bone density and clinical evaluation is essential for early intervention and effective management.

Imaging:

- DEXA (Dual-energy X-ray Absorptiometry): Gold standard for BMD measurement.
- Ultrasound & Quantitative CT: Less commonly used.
- Bone Biopsy: Rare; used for suspected bone tumors.

Laboratory Tests:

- Baseline Tests: CBC, liver function, serum chemistry.
- Vitamin D (25-hydroxyvitamin D): Assesses deficiency.
- Thyroid Function: TSH to detect thyroid disorders.

Bone Turnover Markers:

- Formation: Alkaline phosphatase, osteocalcin.
- Resorption: β-CTX, NTX.
- Serum Protein Electrophoresis: Screens for multiple myeloma.

Other tests:

- 24-Hour Urine Calcium/Creatinine: Evaluates calcium metabolism.
- Hormone Tests in Men: Testosterone, LH, FSH (detects hypogonadism).

Risk Increases:

- Doubles in osteopenia.
- Quadruples in osteoporosis.

BMD Testing Recommendations:

- Women ≥65 years and men ≥70 years.
- Younger postmenopausal women and men 50–69 with risk factors.
- Adults with prior fractures.
- Individuals with conditions or medications that increase bone loss.

HOMOEOPATHIC APPROACH(4–9)

Common homoeopathic medicines for osteoporosis:

- **Calcarea phosphorica** – Defective bone development; non-union of fractures; bone pains < cold; rickets, osteomalacia; rapid growth in children.

- **Calcarea carbonica** – Cold extremities, fatigue, obesity tendency; weak, degenerating bones.
- **Symphytum officinale** – Promotes callus formation; aids fracture healing.
- **Silicea** – Poor assimilation; bone and connective tissue nutrition; caries, bone decay, chilliness, low resistance; promotes repair.
- **Phosphorus** – Bone affections in tall, thin, nervous types; burning pains; bleeding; bone destruction; spinal weakness.
- **Fluoricum acidum** – Degenerative bone/connective tissue changes; brittle bones in elderly; varicosities; osteitis, caries.
- **Ruta graveolens** – Acts on periosteum, cartilage; bruised, aching bones; post-traumatic pain.
- **Mezereum** – Painful long bones < night; caries, chronic inflammation.
- **Angustura vera** – Oversensitive, brittle long bones; easy fracture; joint stiffness, cracking.
- **Bryonia alba** – Osteoporotic pain < slightest motion, > rest, pressure.
- **Aurum muriaticum natronatum** – Bone destruction in chronic syphilitic/degenerative states; nasal, cranial bone caries.
- **Hekla lava** – Exostosis, osteitis, jawbone caries, esp. post-extraction/trauma.
- **Syphilinum** – Chronic bone disease; deep nocturnal pain; inherited syphilitic deformities.
- **Kali iodatum** – Long-standing bone pain < night, warm bed; periosteal swellings; tibial pain.
- **Phosphoric acid** – Bone weakness from grief, mental strain, seminal loss; thin, weak patients.
- **Picric acid** – Early spinal osteoporosis; mental exhaustion; lower limb weakness; burning spine pains.
- **Asafoetida** – Periosteal pains; hypersensitive bones; after suppressed discharges/ulcers.
- **Sanicula aqua** – Poor nutrient assimilation; spinal deformities in children; fragile bones.
- **Fluoricum acidum** – Brittle bones, deformities, early senility; destructive diseases.
- **Manganum aceticum** – Inflammation of bones or joints with nightly digging pains.

- **Mercurius vivus** – Syphilitic bone pains < night; offensive sweat; caries with glandular swelling

Clinically verified medicines mentioned in Homeopathic Repertory (Synthesis)(10)

- EXTREMITIES – OSTEOPOROSIS: Bor-pur. cortiso. dys. Mucor
- GENERALS – OSTEOPOROSIS: arg-met. bacls-7. calc-f. cortico. cortiso. dys. fl-ac. morg-p. palo.
- GENERALITIES – BRITTLE bones – general: asaf. banis-c. bar-c. bufo calc-f. calc-p. Calc. carc. cor-r. cupr. fl-ac. Lac-ac. lyc. Merc. par. ph-ac. pip-n. rutaSIL. sulph. Symph. thuj.
- GENERALS – SOFTENING bones: am-c. ASAF. aur. bar-c. Bell. bufo calc-f. Calc-i. calc-p. CALC. caust. cic. con. Ferr-i. ferr-m. Ferr-p. ferr. guaj. hecla Hep. iod. ip. Kali-i. Lac-c. Lyc. mag-f. mag-p. MERC. mez. Nit-ac. nux-m. Ol-j. parathyr. petr. ph-ac. Phos. plb. Psor. Puls. rhod. ruta Sep. SIL. staph. Sulph. syph. ther. thuj.
- GENERALS – BONES; complaints of: Arg-met. ASAF. aur. bell-p-sp. Calc-f. Calc-p. Calc. castor-eq. chin. chlam-tr. cocc. cupr. daph. eup-per. fl-ac. hep. kali-bi. kali-i. lyc. merc-pr-r. merc. mez. Nit-ac. PH-AC. Phos. Phyt. PULS. pyrog. rhod. rhus-t. Ruta sel. sil. staph. Sulph. Syph.

In Murphy's Homeopathic repertory :(10)

- GENERALS – OSTEOPOROSIS : arg-met, bacls-7. Calc f, Cortico, cortiso, dys, fl-ac, morg-p.
- EXTREMITIES – OSTEOPOROSIS : Bor-pur, cortiso, dys, mucor,
- Clinical – DECALCIFICATION, bones : Calc, Calc-f, Calc-p, cor-r, hecla, sil, symph.

Study	Population & Method	Key Findings	Conclusion
1. Prevalence of Osteoporosis and Associated Risk Factors among Postmenopausal Women: A Cross-Sectional Study from Northern India(11)	587 postmenopausal women (aged 50–80); DEXA scan	High prevalence of osteoporosis in women with ≥6 children, late menopause, tobacco use, and family history of fractures.	Multiparity, low education, and prolonged menopause are key risk factors.
2. Prevalence of osteoporosis in India:	31,238 adults screened via	Osteopenia: 49.9%, Osteoporosis:	One in five adults has osteoporosis;

an observation of 31238 adults(12)	calcaneal ultrasound	18.3%; Postmenopausal osteoporosis: 33.1%	prevalence higher in women and elderly
3. Prevalence of Osteoporosis in Apparently Healthy Adults above 40 Years of Age in Pune City, India(13)	421 adults (aged 40–75); DEXA at spine and femur	Rapid BMD loss in postmenopausal women; men had lower T-scores than premenopausal women.	Both postmenopausal women and men are vulnerable and need preventive care.
4. A study to assess the knowledge regarding osteoporosis and related fractures among peri menopausal women of Indian society(14)	50 women (aged 40–55) with skeletal pain; interviews & DEXA.	62% had significant knowledge deficit; grouped into high, moderate, and low priority based on BMD and BMI.	Urgent need for education and intervention among high-risk groups.
5. High Prevalence of Osteoporosis and Morphometric Vertebral Fractures in Indian Males Aged 60 Years and Above: Should Age for Screening Be Lowered?(15)	241 men (aged 60+); DEXA screening.	Osteoporosis: 19%, Osteopenia: 56%; highest in men >80 years (50%)	Screening age for men should be lowered to 60 due to high prevalence
6. Effectiveness of Homoeopathic Medicines in Treatment of Osteoporosis in Post Menopausal Age- A Case Report(16)	Case report of 1 case	: A 56-year-old postmenopausal woman presented with generalized bone pain, easy fatigability, and reduced mobility. Her DEXA scan showed significant reduction in bone mineral density (T-score: –2.8).	After thorough case-taking, individualized homoeopathic treatment was administered. Over a period of one year, the patient showed remarkable clinical improvement with improved DEXA score (T-score: –1.9) and better quality of life.

CONCLUSION:

The constant weakening of bones caused by osteoporosis increases the chance of fractures, which can cause pain, deformity, and decreased mobility. Throughout the world, osteoporosis is getting more common, and many cases remain neglected until difficulties appear. Periodic screening is advised for postmenopausal women, older men, and those with

risk factors for bone loss because osteoporosis can be identified early by bone mineral density examination. Many remedies with an affinity for bone tissue are available in homoeopathic literature, which can help with prevention, strengthening, and healing. Studies on homoeopathy in the treatment of osteoporosis have provided positive results; however, larger sample sizes and randomised controlled trials have to be done to further show the evidence-based effectiveness of homoeopathy in osteoporosis treatment.

ETHICAL APPROVAL:

This study did not require approval from an Institutional Review Board.

PATIENT CONSENT DECLARATION:

Patient consent was not necessary as no human participants were involved in this study.

CONFLICTS OF INTEREST:

The authors declare no conflicts of interest.

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