

Osteoporosis: The Silent Disease

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Osteoporosis commonly known as the “Silent Disease”, is characterized by low bone mass and structural deterioration of bone tissue, leading to bone fragility and an increased risk of fractures.⁴ It is estimated that 300,000 people in Ireland and approximately 200 million people worldwide are affected by the condition. Osteoporosis is the most common metabolic bone disease in Ireland and increases the risk of 'fragility fractures'. These fractures occur mainly at the hip, vertebrae, and distal forearm and are associated with significant morbidity, mortality, and reduced quality of life, attributed not only to the fracture itself but also to the high prevalence of comorbidities in this patient population.⁶ The prevalence of osteoporosis is expected to increase significantly in the future because of population ageing. Osteoporosis is the most common bone disease worldwide and a major public health hazard, with high morbidity, mortality and socio-economic costs.⁸ Osteoporosis mainly occurs in postmenopausal women and elderly men. A postmenopausal woman's annual risk of fracture is greater than her combined risk of cardiovascular disease and breast cancer.⁸ One in 4 men and 1 in 2 women over the age of 50 will develop a fracture due to osteoporosis in their lifetime. The disease can also affect children. According to the Irish Osteoporosis Society (IOS), 20% of people aged 60 and above who sustain a hip fracture will die within 6 to 12 months, due to secondary complications and 50% of people over the age of 60 who sustain a fractured hip will lose their independence. Only 15% of people in Ireland are actually diagnosed with bone loss, leaving an estimated 280,000 people undiagnosed.¹

Signs and Symptoms of Osteoporosis⁹

A fragility fracture occurs when a person sustains a broken bone from a force less than or equal to that sustained from a fall from a standing position. With severe osteoporosis even forces as minor as a cough, sneeze, turning over in bed or lifting a small weight can result in a fracture.⁹

Development of a kyphosis - A stooped posture where the person's head is bent forward may result from an anterior wedge fractures of the spine. In severe cases a Dowager's hump may develop on a person's upper back which is a strong indication that osteoporosis should be considered.⁹

Loss in height 2-16cm. Height loss >2 inches is an important sign of an asymptomatic vertebral fracture and should be evaluated for osteoporosis. A person can lose height due to wear and tear of vertebrae and/or disc but >2 inches is unusual in degenerative joint and disc disease.⁹

Change in body shape or size associated with loss of height. A distended abdomen can develop as the stomach and intestines push outwards followed by the rib cage resting on the pelvis. These changes can cause difficulty in breathing, back pain, depression, loss of functional independence and gastrointestinal symptoms.⁹

Sharp sudden pain in the low, middle or upper back, especially with height loss should be **evaluated for vertebral fractures** as this may be the first presentation of an osteoporotic fracture. When plain films are normal and symptoms persist, repeat X-rays several weeks later or additional imaging may show a fracture. Cause of back pain should always be addressed and vertebral fractures ruled out.⁹

Causes

Osteoporosis is multifactorial in origin. It occurs when there is an imbalance between new bone formation and old bone resorption. Bone turnover is regulated by the interaction between osteoblasts and osteoclasts. Osteoblasts form new bone and osteoclasts are responsible for bone resorption. Both types of cell are under hormonal regulation. Up to 90 percent of peak bone mass is acquired by age 18 in females and age 20 in males. The amount of bone mass in the skeleton can keep increasing until a person reaches their late 20's, at which point, bones have reached their maximum strength and density, known as peak bone mass. As people age the rate of bone resorption by osteoclast cells exceeds the rate of bone formation, so bone weakens. The greatest cause of osteoporosis is oestrogen deficiency which results in increased bone turnover in which resorption exceeds formation. Corticosteroids can also induce osteoporosis in which trabecular bone is particularly affected from suppression of osteoblastic activity.¹⁰ Peak bone mass is the major determinant of adult bone density. Peak bone mass has a strong genetic component, with between 60 and 85% of the variance in bone mineral density (BMD) being attributable to genetic factors.¹² Certain risk factors are linked to the development of osteoporosis and contribute to an individual's likelihood of developing the disease. Some risk factors are modifiable while others are not.^{4,5}

Modifiable and Non-modifiable Risk Factors for Osteoporosis^{4,5}

Modifiable Risk Factors	Non-modifiable Risk Factors
<p>Sex hormones: The reduction of oestrogen levels in women at menopause is a strong risk factors for developing osteoporosis. Men have a gradual reduction in testosterone levels as they age. Treatments for prostate cancer that reduce testosterone levels in men and treatments for breast cancer that reduce oestrogen levels in women accelerate bone loss.</p>	<p>Sex: Women are much more likely to develop osteoporosis than men. Women have less bone tissue and lose bone faster than men because of the changes that occur with menopause</p>
<p>Endocrine: Too much thyroid hormone can cause bone loss. This can occur in hyperthyroidism or if too much thyroid hormone medication is used to treat an underactive thyroid. Osteoporosis has also been associated with overactive parathyroid and adrenal glands and hypogonadism.</p>	<p>Age: The risk of developing osteoporosis as bones become thinner and weaker increases with age.</p>

<p>Medication use: Long-term use of certain medications, such as glucocorticoids and some anticonvulsants can lead to loss of bone density and fractures. Depo-Provera contraceptive has been proven to cause bone loss, particularly high risk if given during adolescence when bone is being laid down.</p>	<p>Body size: People who have small body frames tend to have a higher risk of developing osteoporosis because they have less bone mass to draw from as they age</p>
<p>Lifestyle factors: An inactive lifestyle can lead to weakened bones and increased risk of osteoporosis. Cigarette smoking and excessive consumption of alcohol increases the risk of bone loss and fractures.</p>	<p>Ethnicity: White and Asian women are at highest risk. African American and Hispanic women have a lower but significant risk.</p>
<p>Poor diet increases the risk for osteoporosis. Low calcium and Vitamin D intake contributes to diminished bone density, early bone loss and an increased risk of fractures. Eating disorders, severely restricting food intake, low BMI and being underweight weakens bone in both men and women.</p>	<p>Genetic: A family history of osteoporosis is a very strong risk factor. People whose parents have a history of fractures also seem to have reduced bone mass and may be at greater risk for fractures.</p>

Diagnosis

Osteoporosis is a silent disease without obvious symptoms until a fracture occurs. Bone turnover biomarker detection can be useful in monitoring osteoporosis treatment and assessing fracture risk but not for diagnosis of osteoporosis.⁶

Osteoporosis can be diagnosed by:⁸

1. The presence of a fragility fracture
2. Measurement of bone mineral density (BMD)
- 3 Bone biopsy. Bone biopsy is a diagnostic procedure restricted to untypical, unclear and complicated cases in evidence-based guidelines on diagnosis and treatment of osteoporosis. Bone Biopsy is not routinely used and should never be undertaken without consultation with a specialist in osteoporosis and metabolic bone disease.

The majority of fractures occurring after 50 years of age are osteoporotic. All persons presenting with a fragility fracture after 50 years of age or menopause should be considered as possibly osteoporotic. A detailed history of the fracture occurrence, physical examination and evaluation for other fractures is carried out while noting any presence of back pain, kyphosis, and height loss. Baseline laboratory tests include: Full blood count: Serum chemistry levels: Liver function tests: Thyroid-stimulating hormone level: 25-Hydroxyvitamin D level: Serum protein electrophoresis: 24 hour urine calcium/creatinine: Testosterone (total and/or free) and luteinizing hormone/follicle-stimulating hormone.¹¹ Additional testing should include measurement of bone mineral density (BMD) and if there is height loss and/or back pain, imaging of the spine. On average BMD is lower in women than in men, because women have smaller bones and smaller trabeculae.

Women, as they also go through the menopause lose more bone in their lifetime than men; 50% in females Vs 35-40% in males.⁸

The Fracture Risk Assessment Tool “FRAX” developed in 2008 provides a prediction tool for assessing an individual’s risk of fracture in order to provide general clinical guidance for treatment decisions. It has been adapted to the Irish population using estimates about life expectancy and fracture incidence in Ireland. The Irish Fracture Risk Assessment (FRAX) tool has been calibrated using national hip fracture incidence data and Irish mortality rates.¹⁵ FRAX computes the 10-year probability of a hip fracture or a major osteoporotic fracture.⁸ Eight identifiable risk factors shown to improve the prediction of fracture risk are included in FRAX including: age, family history of hip fracture, glucocorticoid use, current smoking, alcohol use and rheumatoid arthritis. Individually, the presence of these risk factors are shown to increase the risk of hip fracture at least 1.5 to 2-fold after adjustment for bone mineral density. FRAX has some limitations, as it only accepts one risk factor; while many cases of osteopenia and osteoporosis have multiple risk factors, which can significantly increase their risk of fractures.⁸

A DXA scan is used to measure bone mineral density (BMD) of the spine and hips which helps to assess the risk of bone fractures. DXA scans are most commonly used for diagnosing osteoporosis and assessing the risk of osteoporosis developing. BMD is mainly described as T-score, which represents the standard deviation (SD) number by which the BMD in an individual differs from the mean value expected in young healthy individuals. T scores should only be used in the diagnosis of adults over 21 years of age.⁷

According to the World Health Organization (WHO) criteria, osteoporosis is defined as a bone mineral density (BMD) that lies 2.5 standard deviation (SD) or more below the average value for young healthy women (a T-score of < -2.5 SD).⁶ The World Health Organization, classifies T scores as follows: Above -1 SD is normal. Between -1 and -2.5 SD is classed as osteopenia. Below -2.5 SD is classed as osteoporosis.⁷ DXA also provides the patient’s Z-score, which reflects a value compared with that of persons matched for age and sex. Z-scores should be used in premenopausal women, men younger than 50 years, and children. Z-score values of -2.0 SD or lower are defined as below the expected range for age and those above -2.0 SD as within the expected range for age.¹¹

Osteopenia is the early stage of osteoporosis and places a person at risk of developing osteoporosis. The Irish Osteoporosis Society divides osteopenia into three categories.²

1. Mild Osteopenia is a T-score of -1 to -1.49 and usually requires lifestyle changes; however causes should be investigated and addressed.
2. Moderate Osteopenia is a T-score of -1.5 to -1.9 which usually requires lifestyle changes. Causes should be found and addressed and the person may require medication, depending on the cause, or if they have had a fragility fracture.
3. Marked Osteopenia is a T-score of -2 to -2.49 which requires lifestyle changes. Causes should be found and addressed and the person may require medication, depending on the cause, or if they have had a fragility fracture.

Treatment

Osteoporosis is treatable and fractures are preventable. The primary goal of osteoporosis therapy is

to reduce the risk of fracture. A comprehensive osteoporosis treatment program includes a focus on proper nutrition, exercise, and safety issues to prevent falls that may result in fractures. In addition, medication to slow or stop bone loss, increase bone density, and reduce fracture risk may be prescribed.⁴ The treatment selected for each individual is based on their risk of fracture or re fracture, causes of osteoporosis, age, DXA scan results and medical history. Assessment of bone markers before and at three and six months after the commencement of treatment will give an earlier indication of the response to treatment.^{8,9}

All postmenopausal women and individuals at risk of osteoporosis should be encouraged to maintain a healthy weight, ensure adequate calcium, vitamin D and protein intake and avoid excessive alcohol consumption and smoking. They should participate in appropriate exercise to improve muscle strength, balance, and maintain bone mass and utilise measures that prevent falls.
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Calcium and Vitamin D supplements

Calcium and vitamin D are essential for the prevention and treatment of osteoporosis. Bone is a major store of calcium and phosphate. Every cell in the body requires calcium. Vitamin D helps to regulate cell growth and the immune system and is essential for the absorption of calcium. It increases the body's ability to absorb calcium by 30-80%. Vitamin D is the only vitamin required by the body that does not have to be consumed through food or supplements as it is manufactured through the skin, when exposed to sunlight. Supplements are generally only recommend when the daily amounts of calcium and Vitamin D from dietary sources are not being met. Many people however do not get the recommended amounts of vitamin D through food or sunlight, and supplements are often recommended.^{6,8} In Ireland the RDA of calcium is 800 mg/day for children, adults and older people, increasing to 1200 mg for teenagers, pregnant and lactating women. The National Osteoporosis Foundation in the USA recommends 1000mg-1200mg calcium and 800-1000IU of vitamin D for adults aged 50 years and older.¹³

Recommended Daily Allowances of Calcium and Vitamin D			
	Age (years)	Calcium (mg/day)	Vitamin D (µg/day)
Babies	0-1	N/A	5 (as supplement)
Children	1-3	800	10
	4-6	800	0-10
	7-10	800	0-10
Males & Females	11-14	1200	0-15
	15-18	1200	0-15
Males & Females	19-64	800	0-10

	65+	800	10
	Pregnancy	1200	10
	Lactation	1200	10

Reference: Irish Nutrition + Dietetic Institute (INDI, 2013)

The richest sources of calcium in the diet are milk, cheese and yogurt. Three servings a day help meet the calcium needs of an adult or child and five servings are recommended during adolescence and pregnancy. Smaller amounts of calcium may be obtained from green vegetables, bread and sardines. The bioavailability of calcium from non-dairy sources is lower. Foods fortified with calcium and vitamin D can also be useful.¹³ Vitamin D is primarily produced by the action of UVB light on skin. A limited number of foods such as oily fish, egg yolks, liver and fortified dairy products also provide vitamin D. Due to Ireland's northerly latitude and the use of sunscreens, Vitamin D production from UVB light is compromised. Together with poor dietary intake, this has contributed to wide-spread sub-optimal vitamin D status. Low vitamin D status (25 hydroxyvitamin D < 50nmol/l) is prevalent in Ireland particularly in postmenopausal women. Dietary sources should be encouraged in all ages. Calcitriol is a Vitamin D analogue. It is licensed for the treatment of established post-menopausal osteoporosis. Patients should have serum calcium and creatinine monitored for hypercalcaemia. Malnourished adults particularly those with an inflammatory condition are at increased risk of bone loss. Particular attention should be paid to the calcium intakes of individuals at risk of osteoporosis due to conditions such as coeliac disease, malabsorption or inflammatory bowel disease.¹³

HRT – Hormone Replacement Therapy

Oestrogen replacement for women going through the menopause can help to maintain bone density and reduce fracture rates while they are on the treatment. There is a direct relationship between the lack of oestrogen after menopause and the development of osteoporosis. Early menopause before age 45 and any long phases in which the woman has low hormone levels and no or infrequent menstrual periods can cause loss of bone mass. Oestrogen therapy and oestrogen with progesterone hormone therapy are approved for the prevention of osteoporosis in postmenopausal women provided there are no contraindications. HRT is not suitable for people who have a history of breast cancer in their family, particularly in early menopausal patients or patients who have had a history of deep vein thrombosis.^{8,9}

Selective Estrogen Receptor Modulators (SERMs)

SERMs, brand name Evista® work in a similar manner to oestrogen on bone, by preventing bone loss in postmenopausal women who do not have hot flushes and provided there are no other contraindications. It is used for the prevention and treatment of osteoporosis in postmenopausal women and to reduce risk of invasive breast cancer in postmenopausal women at high risk or with osteoporosis. Evista helps to maintain bone density and reduce fracture rates, specifically at the spine. It is administered as a 60mg tablet once daily. Evista can be taken with or without food or

drink and at the same time as calcium and vitamin D supplements. Appropriate weight bearing exercise is also necessary.^{8,9}

Monoclonal Antibody

Denosumab, brand name Prolia, is a monoclonal antibody which binds to RANK Ligand, inhibiting the maturation of osteoclasts, therefore protecting the bone from degradation. Prolia is indicated for the treatment of osteoporosis in postmenopausal women and in men at increased risk of fractures. In postmenopausal women Prolia reduces the risk of vertebral, non vertebral and hip fractures. Prolia is also indicated for the treatment of bone loss associated with hormone ablation in men with prostate cancer at increased risk of fractures. It is the first choice of drug for those at high risk of hip fracture or who have had a hip fracture over the age of 75 with T scores < -2.5 at femoral neck or with a humeral fracture. The recommended dose of Prolia is 60 mg administered as a single subcutaneous injection once every 6 months into the thigh, abdomen or upper arm. Patients must be adequately supplemented with calcium and vitamin D.^{9,14}

Bisphosphonates

Bisphosphonates also known as antiresorptive medications are non-hormonal drugs which help maintain bone density and prevent further bone loss. These medications, such as Boniva, Fosamax, Fosavance, Actonel and Aclasta are potent inhibitors of bone resorption and mainly increase the BMD of trabecular bones. Bisphosphonates are poorly absorbed from the GI tract. They should be taken alone on an empty stomach first thing in the morning with at least 250 mls of water. After administration, the patient should not have food, drink, medications, or supplements for at least a half-hour.^{6,9}

Parathyroid Hormone – (PTH) brand name preotac is a bone forming agent that stimulates the formation of new bone administered as a daily 100mcg dose, subcutaneous injection in the thigh or abdomen for 24 months. It can only be prescribed by a Consultant, as it is a 'high tech' drug for severe osteoporosis. It is contraindicated in patients with cancer. Patients need to have follow up tests done at 1, 3 and 6 months, for elevated serum or urinary calcium. The patient should then have a repeat DXA scan and a new treatment plan should be implemented at the end of the course of treatment.⁸

Parathyroid hormone - (PTH) teriparatide, brand name Forsteo is a recombinant human parathyroid hormone 1-34 and a bone forming agent that stimulates the formation of new bone. Forsteo is a 'high tech' medication that can only be prescribed by a Consultant. It is given as a daily 20mcg, subcutaneous injection in the thigh or abdomen for 24 months. The patient should then have a repeat DXA scan and a new treatment plan should be implemented at the end of the course of treatment. PTH is usually recommended for those with severe osteoporosis or fractures and those who cannot tolerate other medications. Forsteo can help with the pain of vertebral fractures and the reduction of vertebral and non-vertebral fractures in women.^{8,9}

Other treatments for osteoporosis can include Kyphoplasty and Vertebroplasty:⁹

Kyphoplasty is a surgical treatment involving a balloon being placed into the fractured vertebrae,

followed by “bone cement” being injected into the balloon. **Vertebroplasty** is a non-surgical treatment involving a needle with “bone cement” inserted into the fractured body of the vertebrae under imaging guidance.⁹ The decision to perform these techniques is made by a multi-disciplinary team to insure that this is the correct approach to managing the collapse.

Many of the consequences of osteoporosis, particularly vertebral fractures, are associated with severe pain. Patients with established osteoporosis should be treated for pain relief and physiotherapy offered for the secondary effects of osteoporosis. Pharmaceutical and non pharmaceutical measures can be used to alleviate pain. Patients should be advised of all the options, and encouraged to try different approaches until they find what works best for them. Forsteo and Protelos can help with the pain of vertebral fractures. Protelos has a dual action, it reduces bone resorption, prevents bone loss and increases bone formation and bone mineral density (BMD) through the formation of new normal strong bone.⁸

Assessment and treatment for osteoporosis can be well managed in Primary Care settings. Practice Nurses play an essential part in the delivery of quality primary care, and have a growing responsibility in the screening, assessment, treatment and management of long term conditions including osteoporosis. A holistic person-centred approach is required in the management of patients with osteoporosis providing ongoing assessment, management, support and education. Key roles are to establish a therapeutic relationship with the patient, assess their understanding of the condition, establish goals and expectations for successful management of their condition and evaluate the physical, emotional, and psychological effects of the condition on their well-being. Assessment, monitoring, audit and evaluation for disease activity, progression, and effects of the therapeutic regime on a patient with osteoporosis is a continuous process. By implementing person-centred care, monitoring and evaluating symptoms, outcomes and responses to therapy, GP and Practice Nurses play a pivotal role in managing the illness and improving the patient’s quality of life.

Prevention of osteoporosis should ideally start in utero. Childhood and teenage years, are critical periods for developing strong healthy bones, especially before puberty, between the ages of 8 and 12 years. If good peak bone strength is achieved in early childhood, the risk of osteoporosis in later life is reduced.⁸ The Irish Osteoporosis Society recommends that from birth throughout life, everybody should receive the RDA of calcium and vitamin D.⁸

The Irish Osteoporosis Society a charitable organisation, is the only organisation in the Republic of Ireland that deals specifically with osteoporosis. It was founded by Professor Moira O’Brien in 1996 as a patient support organisation for people with osteoporosis and their families. The IOS provides information to the public and health professionals on all aspects of the disease and offers support to people with osteoporosis and everyone at risk from the disease. The IOS aims to; Increase awareness and significantly decrease the number of people affected by osteoporosis in Ireland; establish a network of local awareness groups and provide support, advice and information for people with osteoporosis; distribute up-to-date information to healthcare professionals on current methods of prevention and treatment and encourage research in this area in Ireland. The Irish Osteoporosis Society helpline is open Monday to Friday 9am to 5pm. Telephone 01 637 5050.³

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