

# Osteoporosis: Primary Prevention in the Community

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## SUMMARY

The incidence of osteoporosis is increasing worldwide. It has great impact on the life of the elderly population. The most significant medical consequence of osteoporosis is fragility fracture which without proper treatment will cause severe medical and psychosocial complications. The overall cost in managing osteoporosis and its related fractures is escalating. Using bone densitometry to measure bone mineral density is useful in the diagnosis of osteoporosis but it is costly and not feasible in the community. Drugs such as estrogen replacement, raloxifene and calcitonin are effective in prevention and treatment of osteoporosis but they are also expensive. Identifying modifiable risk factors such as smoking, lack of exercise, low dietary calcium and vitamin D intake and healthy life style remain strategy in the primary prevention of osteoporosis in the community.

## INTRODUCTION

Osteoporosis remains one of the most important public health issues affecting the elderly population. It is a silent progressive disease and becomes clinically evident when there is a fracture. In view of its clinical significance, the World Health Organization (WHO) formed a working group in 1994 to define osteoporosis. Osteoporosis is defined as "a progressive systemic skeletal disease characterized by low bone mass and micro- architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture"<sup>1</sup>. Bone densitometry is the most widely used imaging technique for objective measurement of bone mineral density (BMD). The BMD is expressed as T-score. The WHO working group recommended that the diagnosis of osteoporosis is based on T-score of at least - 2.5 standard deviation<sup>1</sup>. The most important consequence of osteoporosis is bone fracture particularly involving the vertebrae, hips and forearm. Many of these are fragility fractures caused by trivial force which usually should not cause a fracture in healthy individuals. Severe osteoporosis is defined as BMD value of at least T-2.5 standard deviation or more below the young adult mean with the presence of one or more fragility fractures.

### Magnitude of the problem

According to the WHO working group definition, about 30% of postmenopausal women suffer from osteoporosis<sup>1</sup>. Published studies worldwide indicate that the incidence of osteoporosis is increasing yearly. In Hong Kong, the incidence is approximately 10 per 1000 population in women and men above the age of 70 years old<sup>2</sup>. The prevalence of osteoporosis in Malaysia was reported as 24.1% in 2005, predominantly

affecting the hip<sup>3</sup>. Prevalence of osteoporosis in Thailand was 12.6%,<sup>4</sup> in China 16.1%<sup>5</sup> and in Taiwan 10.08%<sup>6</sup>. The overall prevalence of osteoporosis in the Asian population is higher than the western countries due to the fact that the Asian population has lower body mass index and shorter height<sup>7</sup>. A study conducted in the United States comparing immigrant Chinese women from Hong Kong and Mainland China showed lower BMD at both the lumbar spine and femoral neck compared to US Caucasian women<sup>7</sup>. It was also projected that 50% of all fragility fractures in the world will occur in Asia by the next century<sup>2</sup>.

### Impact of osteoporosis

Osteoporosis has great impact on the society. The most significant medical problem associated with osteoporosis is fragility fracture. Among the well documented sites of fractures are the spine, hips and arms. Fractures of the spine, vertebrae and hips are associated with long term morbidity such as chronic pain, deformity and disability. A study done in Japan had shown a significant correlation between annual bone mass reduction and decreased activity of daily living of the elderly population<sup>8</sup>. Indirect morbidities include depression, self isolation, low self esteem and loss of independence following fracture. Each episode of fracture also increases the future risk of fracture; for example femoral neck fracture carries a relative risk of 1.5 for further fracture in the future<sup>9</sup>.

The costs involved in the diagnosis and management of osteoporosis related fracture is another great concern affecting health care policy planning. Studies done in Europe documented hip fracture unit cost was the highest, ranging from Euro 8,346 for Italy to Euro 9,907 in France<sup>10</sup>. Similar findings were reported in Thailand where the cost incurred from diagnosis and management of hip fracture in one year was high amounting to 116,458.6 Baht<sup>11</sup>. In Malaysia, the direct cost for hospitalization due to hip fracture in 1997 was estimated at Ringgit Malaysia 22 million<sup>12</sup>. This is a huge amount which most patients in the developing country cannot afford. Rising yearly incidence of osteoporosis will have a significant impact on the healthcare financing system of the country.

### Pathogenesis and Risk factors

Primary osteoporosis is characterized by reduction of bone mass due to the ageing process. Secondary osteoporosis is caused by exogenous drugs or systemic disease affecting bone metabolism. These causes (Table I) must be excluded before primary osteoporosis is diagnosed as some of these are treatable medical conditions. Recent studies had postulated

*This article was accepted: 22 August 2007*

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**Table I: Secondary causes of osteoporosis**

Endocrine disorder: Hyperthyroidism, hyperparathyroidism, Cushing disease
Gastrointestinal problems: Post gastrectomy, chronic liver disease, malabsorption syndrome
Bone disease: osteogenesis imperfecta, malignancy.
Drugs: Steroids, heparin, frusemide, thyroxin, progesterone, cytotoxic drugs.
Others: hypercalciuria, vitamin D deficiency, Hemochromatosis, hypophosphatasia

**Table II: Common risk factors for osteoporosis**

Modifiable risk factors	Non modifiable risk factors
Smoking	Ageing
Sedentary life style	Postmenopausal
Low body mass index	Female
Past history of fracture	Family history of osteoporosis/fracture
Low calcium and vitamin D intake	Small body build
Malnutrition	Asian population
Drugs: steroids, heparin, thyroid hormone	

a few mechanisms in the pathogenesis of primary osteoporosis. One theory is related to chronic inflammatory process influence on the bone turnover. Pro-inflammatory cytokines have been implicated in the regulation of osteoblasts and osteoclasts and activation of immune system in the ageing process<sup>13,14</sup>. Pelvic bone marrow adipose tissue (BMAT) is another factor postulated in the pathogenesis. MRI-measured BMAT is strongly inversely correlated with DXA-measured BMD independent of other predictor variables<sup>15</sup>. More research in this area is currently being carried out. The risk factors for osteoporosis are well established in many epidemiological studies. They are classified into modifiable and non-modifiable risk factors. (Table II) Intervention on the modifiable risk factors forms the basis for counseling and primary prevention of osteoporosis in the community.

**Preventive measures of osteoporosis in the community**

Among the proven effective measures in the primary prevention of osteoporosis are:

- (1) life style modification
- (2) Calcium and vitamin D supplements and
- (3) the use of medication to prevent bone loss.

**Life Style modification**

Majority of the patients in the community usually have a combination of the risk factors. All risk factors need to be assessed and a planned life style modification is necessary. Published research in the west and east both have documented smoking as a major risk factor for osteoporosis. Lower bone mineral density and reduced cortical thickness leading to fragility fractures were reported in many community studies<sup>15,16</sup>. Therefore, quitting cigarette smoking is an important strategy in both primary and secondary prevention of fracture. Physical activity and exercise are protective factors for osteoporosis<sup>17</sup>. Sedentary life style increases the risk of osteoporosis. Regular physical exercise gives the effect of mechanical stress on bone remodeling and is associated with increased bone strength besides increasing muscle bulk and strength, thus reducing the risk of fall<sup>17</sup>. There is no solid data on which type of exercise is best to prevent osteoporosis; most doctors will advise on regular weight bearing exercises such as daily walking. Other lifestyle

factors such as reduced alcohol and caffeine intake are also important factors to be considered in preventing osteoporosis.

**Calcium and vitamin D supplements**

A high dietary calcium intake and calcium tablet supplement have been proven to reduce the risk of osteoporosis. Studies done in Malaysia have also demonstrated ingestion of high calcium skimmed milk effective in reducing the rate of bone loss<sup>18</sup>. The recommended daily calcium intakes is 1,200-1,500 mg/day in Western population and 800mg/day in Japan<sup>19</sup>. The total daily intake of calcium should not exceed 2000 mg in view of the risk of renal dysfunction. Side effects include indigestion and constipation. Vitamin D helps in maintaining normal calcium absorption and metabolism. Exposure to sunlight is a major source of vitamin D in tropical countries. Recommended vitamin D intake above the age of 50 is about 10 ug/day (about 200-600 i.u.)<sup>20</sup>. Food that contains high calcium and vitamin D such as milk, cheese, egg and cod liver oil should be encouraged.

Besides the above measures, the patient must be counseled about medicines which he or she is taking for chronic medical disorder which may lead to osteoporosis. Steroids, thyroid hormones and frusemides are well known to cause osteoporosis.

**Medication preventing bone loss**

The three most widely used medications in preventing bone loss are Bisphosphonates, estrogen replacement therapy and raloxifene. Bisphosphonates inhibit osteoclast activity and reduce bone turn over and have been proven in many clinical trials as an effective agent in the prevention and treatment of osteoporosis. Estrogen replacement therapy (both oral estrogen and trans-dermal patch) has been proven to reduce bone turnover and lower the risk of fracture<sup>22,23</sup>. Many clinical trials have shown that estrogen prevents bone loss at the spine and hips if started within ten years post menopause<sup>22</sup>. However, estrogen is contraindicated in women with a history of breast cancer or history of vascular thrombosis. Stopping this medicine will lead to increased bone loss and the risk of fracture will resurface. Raloxifene is a *selective estrogen-receptor modulator*. Daily therapy with raloxifene increases bone mineral density especially at the spine and

hip, and lowers serum concentrations of total and low-density lipoprotein cholesterol. The effect on any increased of bone mass is slightly less than estrogen but it has the advantage of having no known effect on uterine endometrium stimulation. Another drug used to treat postmenopausal osteoporosis is Calcitonin, a 32-amino-acid peptide which inhibits the action of osteoclasts with resulting increase in BMD. It can be given by subcutaneous, intramuscular injection or intranasal spray<sup>22</sup>. These medications are costly, and the treating physician must consider the cost effectiveness when prescribing.

## CONCLUSIONS

Osteoporosis is an important health problem affecting the elderly population. The yearly incidence of osteoporosis is increasing. This problem has great impact on society, leading to escalating healthcare cost. As the use of medications in the treatment of osteoporosis is expensive, healthy lifestyle and risk factors modification remain the most important primary prevention strategy in the community setting.

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### MULTIPLE CHOICE QUESTIONS

T=True F=False

1. The following are causes of secondary osteoporosis:
  - A. Cushing's disease
  - B. Hypothyroidism
  - C. Long term heparin therapy
  - D. Malabsorption syndrome
  - E. Steroid therapy
  
2. Known modifiable risk factors for primary osteoporosis include:
  - A. Smoking
  - B. High caffeine intake
  - C. Low dietary calcium
  - D. Sedentary life style
  - E. Lack of exposure to sun light
  
3. The following statements are true regarding osteoporosis.
  - A. Asian population has lower incidence of osteoporosis compared to western population.
  - B. It is defined as bone mineral density T score below 2.5 standard deviation of the population according to WHO definition.
  - C. Bone densitometry is the most widely used imaging technique in assessing bone mass.
  - D. Osteoporosis presents with early bone pain.
  - E. Chronic inflammatory process has been postulated in the pathogenesis of osteoporosis.
  
4. Which of the following substance is effective in management of osteoporosis.
  - A. Estrogen
  - B. Raloxifene
  - C. Bisphosphonates
  - D. Thyroxin
  - E. Calcium supplements
  
5. Complications of osteoporosis include:
  - A. Fragility fracture
  - B. Bony deformity
  - C. Reduce activity of daily living
  - D. Depression
  - E. Social isolation