

**ABSTRACT**

With an ageing population, the incidence of osteoporotic fractures leading to deaths and impairment in quality of life. However, despite the availability of effective treatments, osteoporosis is often under-diagnosed and under-treated. Primary fracture prevention means detection of osteoporosis early with timely appropriate treatment to improve the bone and lifestyle and environment optimisation to reduce falls. We propose a population-based combined with high-risk prescreening for measurement of bone mineral density (BMD) to reduce the incidence of fractures in the population.

**Key Words:** Osteoporosis screening; OSTA; FRAX®;

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**INTRODUCTION**

Singapore's population is rapidly ageing due to the combined factors of low fertility and increased life expectancy. By the year 2030, the total number of citizens above 65 years old will have more than doubled from today.<sup>1</sup> This will mean the absolute number of people with osteoporosis will more than double by the year 2030 with a rapid increase in incidence of osteoporotic fractures unless there is early diagnosis and treatment.

The incidence of hip fractures in Singapore has increased by 1.5 times for men and 5 times for women since the 1960s. This, coupled with an ageing population, will lead to an increase in the burden of osteoporotic fractures.<sup>2-3</sup>

Mortality rates at one year for osteoporotic hip fractures in Singapore is between 20 to 27 percent.<sup>4-6</sup> For those who survive, 20 percent will be semi- or fully dependent for their activities of daily living, while 39 percent will require some form of assistance.

However, despite the disease burden of osteoporosis, it is often under-diagnosed. Being a silent disease, it is often forgotten in a patient with multiple chronic diseases until a fracture occurs.<sup>7</sup>

With effective osteoporosis treatment options that are now available, early detection and treatment of the disease would reduce the risk of fractures but also improve the quality of life for the elderly.

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**IMPACT OF OSTEOPOROSIS**

Osteoporosis is a non-communicable disease with a huge impact on individuals as well as a burden on the healthcare system. In the Americas and Europe, disability-adjusted life years (DALYs) for osteoporotic fractures is more than that for hypertension and rheumatoid arthritis.<sup>8</sup> In the Asia Federation of Osteoporosis Societies Study, it was estimated that the direct cost of hip fractures in Asia will increase from the current 9.5 billion USD to 15 billion USD in the year 2050. In order for the total number of hip fractures to remain constant over time, there needs to be an annual 2–3 percent decrease in the incidence of hip fractures.<sup>9</sup> This can be achieved through early detection and treatment of osteoporosis as well as measures to prevent falls.

**DEFINITION OF OSTEOPOROSIS**

The World Health Organisation (WHO) defined osteoporosis as a progressive systemic skeletal disease characterised by low bone mass and micro-architectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fracture.<sup>10</sup>

**DIAGNOSIS OF OSTEOPOROSIS**

Dual-energy X-ray Absorptiometry (DEXA) is the current gold standard for diagnosing osteoporosis. The World Health Organisation defined osteoporosis using Bone Mineral Density (BMD) measured by DEXA (see Table 1).<sup>11</sup> The risk of fracture increases two-fold for every SD decrease in BMD.<sup>12</sup>

While Qualitative Ultrasound (QUS) of the heel has been shown to predict fragility fractures, often the results are discordant and cannot be used for follow up of patients on medical treatment for osteoporosis.<sup>13</sup>

**Table 1: WHO Definitions of Osteoporosis Based on Bone Mineral Density<sup>11</sup>**

WHO Diagnostic Category	BMD T-score (SD) (At either spine or hip)	Description
Normal	≥-1.0	Spinal or Hip BMD within 1.0 SD below the young adult female reference mean (T-score ≥-1.0)
Low bone mass (osteopenia)	<-1 to >-2.5	Spinal or hip BMD between 1.0 and 2.5 SDs below the young adult female reference mean
Osteoporosis	≤-2.5	Spinal or hip BMD more than 2.5 SDs below the young adult female reference mean
Severe/Established osteoporosis	≤-2.5 plus one or more fragility fractures	BMD more than 2.5 SDs below the young adult female reference mean and the presence of one or more fragility fractures

The WHO criteria for osteoporosis is not meant to be used for premenopausal women, men younger than 50 years old, and

children. In these groups, the Z score (age and sex norms) should be used. A low Z score indicates a need for further evaluation to exclude secondary osteoporosis.

**What is a Fragility Fracture?**

A fragility fracture is defined as a fracture that occurs with minimal trauma such as a fall from one’s standing height or lower with no other identifiable major forces. This is usually the result of osteoporosis.

**Aims of Treatment of Osteoporosis**

As with chronic diseases like diabetes mellitus, hypertension, and hypercholesterolaemia, the strategy for osteoporosis is similar. Primary prevention is key and that includes weight-bearing and balance exercises, adequate calcium and vitamin D intake, and falls prevention. Timely screening to detect disease and early appropriate treatment will reduce the risk of a fracture.

**Primary Fracture Prevention**

Primary prevention of any disease is key to the management of any chronic disease and this approach is the same with osteoporosis. However, due to poor public awareness and resource limitations, there is usually a gap in this. In a multi-centre randomised trial conducted in the UK’s primary care sector, it was shown that primary prevention resulted in a reduction in hip fractures.<sup>14</sup> Primary care practitioners need to take on a larger role to reduce fractures in at-risk individuals.

**Secondary Fracture Prevention**

When an individual suffers a fragility fracture, he already has bone fragility and osteoporosis. As such, the individual needs to be treated for osteoporosis after the first fragility fracture. However, in a prospective observational study, it was noted that more than 80 percent of women with a fragility fracture did not receive osteoporosis treatment.<sup>15</sup> To address this, the Fracture Liaison Service (FLS) which consists of a multi-disciplinary team that includes geriatricians, orthopaedic surgeons, and a fracture liaison nurse, has been set up in many countries. Several hospitals in Singapore have also set up such FLS which has been shown to have improved the outcomes after an individual suffers a fracture.

**RISK OF OSTEOPOROSIS AND FRACTURE**

There are many factors that contribute to the risk of developing osteoporosis and, subsequently, fracture. These are listed in Table 2. Clinicians should evaluate their patients for these potential risks and either mitigate the risks or screen for osteoporosis early. The unwanted consequence of osteoporosis will be fractures. Falls remain a key factor in causing fractures in patients with osteoporosis. As such, the risk of falls should ideally be assessed in all patients who are at risk of fractures. Some of these factors that influence falls are listed in Table 3.

**Table 2. Risk for Osteoporosis and Fracture**

Personal Factors	Lifestyle	Secondary Osteoporosis
<ul style="list-style-type: none"> <li>• Personal history of previous fragility fracture as adult</li> <li>• Height loss of more than 2cm over 3 years</li> <li>• History of fracture in a first degree relative</li> <li>• Low body weight (high risk on OSTA)</li> <li>• Elderly age group (high risk on OSTA)</li> </ul>	<ul style="list-style-type: none"> <li>• Current cigarette smoking</li> <li>• Alcohol abuse</li> <li>• Low calcium intake (&lt;500mg/day)</li> <li>• Lack of regular physical activity</li> <li>• Prolonged immobilisation</li> </ul>	<ul style="list-style-type: none"> <li>• Drugs, e.g., prolonged use of corticosteroids (equivalent to prednisolone &gt;7.5mg/day for more than 6 months), excessive thyroxine, anticonvulsant</li> <li>• Ongoing disease conditions, e.g. hypogonadism, hyperthyroidism, hyperparathyroidism, Cushing’s syndrome, chronic obstructive airways disease, liver disease, malabsorption, chronic renal failure, rheumatoid arthritis, organ transplant, diabetes mellitus<sup>16</sup> and anorexia nervosa.</li> <li>• Early natural or surgical menopause before the age of 45 years or prolonged premenopausal amenorrhea lasting &gt;1 year.</li> </ul>

*Adapted from MOH CPG 2008<sup>17</sup>*

**Table 3. Falls Risk**

Personal factors	Environmental factors
<ul style="list-style-type: none"> <li>• One or more falls in the past year</li> <li>• Impaired vision</li> <li>• Polypharmacy with drugs like sedatives, antihistamines, antihypertensives, etc</li> <li>• Gait issues eg. Parkinsonism, stroke, peripheral neuropathy, arthritis, etc</li> <li>• Reduced muscle strength and impaired balance due to ageing and deconditioning</li> </ul>	<ul style="list-style-type: none"> <li>• Slippery or uneven floors</li> <li>• Obstacles on floor, e.g., uneven carpets, wires, toys, etc.</li> <li>• Inadequate lighting</li> <li>• Inappropriate footwear</li> <li>• Others</li> </ul>

*Adapted from MOH CPG 2008<sup>17</sup>*

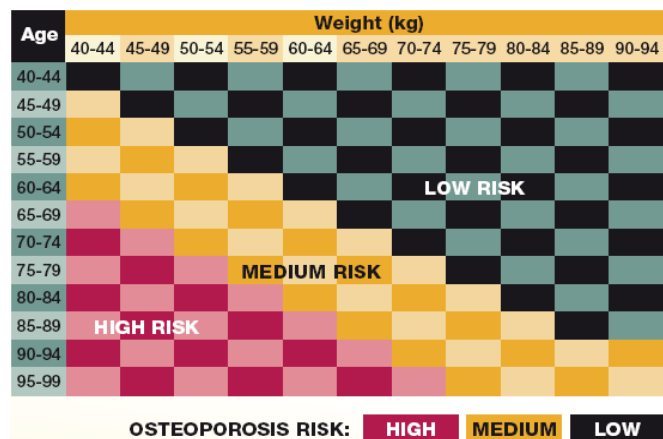
**TOOLS FOR OSTEOPOROSIS SCREENING**

While DEXA remains the gold standard for diagnosing osteoporosis, tools have been developed for pre-screening to select patients for DEXA scans to measure their BMD due to the limitation in DEXA scanners. There are 2 tools which are available for such use in Singapore. They are the Osteoporosis Self-Assessment Tool for Asians (OSTA) and FRAX®.

**Osteoporosis Self-assessment Tool for Asians**

OSTA is a simple tool developed by Koh et al<sup>18</sup> for use in Asians and allows for risk stratification based on age and weight. This tool allows for selecting high-risk Asian populations for BMD measurement. Table 3 shows the chart for classifying patients into high-, moderate-, and low-risk based on the 2 variables of age in years and weight in kilograms. The tool was originally developed for women but has been validated in Chinese men as well.<sup>19</sup>

**Table 4: OSTA**



From Koh LKH et al. A Simple Tool to identify Asian Women at Increased Risk of Osteoporosis. *Osteoporos Int* (2001) 12:699-705. Used with permission. Copyright, MSD

**Fracture Risk Assessment Tools**

FRAX®, a tool developed by the WHO collaborating Centre for Metabolic Bone Diseases at the University of Sheffield, which included the 3 major racial groups in Singapore, namely the Chinese, Malays, and Indians, has been developed for the assessment of fracture risk and is freely available online for use (<https://www.sheffield.ac.uk/FRAX/>). The tool gives an estimate of the 10-year probability of major osteoporotic fracture (namely vertebral, hip, forearm and proximal humerus) and hip fracture and can be used with or without the BMD measurement. There is currently no locally validated threshold for screening or treatment for FRAX®. The National Osteoporosis Foundation uses a threshold of 3 percent at the hip and 20 percent for major fractures to start treatment. A recent study by Kwok et al showed that for the elderly Chinese population in Hong Kong, using the NOF threshold for treatment as a pre-screening tool for measuring BMD is cost effective.<sup>20</sup>

**SCREENING STRATEGIES**

There are currently different screening strategies in different countries as well as professional bodies. The National Osteoporosis Foundation (NOF)<sup>21</sup>, U.S. Preventive Services Task Force (USPSTF)<sup>22</sup>, and ISCD (Asia Pacific consensus)<sup>23</sup> have recommended a population-wide approach for screening with DEXA for all women aged 65 years and above, and men aged 70 years and above. High-risk population screening using OSTA<sup>18</sup> has been recommended for use in Singapore.

Various countries and societies have recommended a combination of population-wide strategy for women 65 years and above and men 70 years and above together with high-risk population screening using a combination of tools such as FRAX® and OSTA as well as clinical risk factors. It is proposed that the combination of population-wide screening combined with high-risk population screening be adopted for better diagnosis of osteoporosis to prevent fractures. Figure 1 shows the suggested strategy for osteoporosis screening in men and women.

**CONCLUSION**

Osteoporosis is a chronic disease which often results in fragility fractures. This has a huge impact on a person’s quality of life, the caregiving burden, as well as the utilisation of the healthcare system. Early detection through timely screening allows appropriate treatment to be instituted to prevent that first fracture.

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**LEARNING POINTS**

- **Osteoporosis is a chronic disease that requires lifelong management to reduce the unwanted consequence of fracture**
- **Reduction of fracture includes treatment of osteoporosis and reduction of falls’ risk**
- **Using population based combined with high risk-based pre-screening to send patients for BMD will allow the early detection of osteoporosis for timely and appropriate treatment.**

Figure 1: Strategy for Osteoporosis Screening in Men and Women

