Managing Osteoporosis in Indigenous Populations

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Prevention and treatment of osteoporosis in all populations

The role of General Practitioners
Osteoporosis Australia

Our Vision
Healthy bones for all Australians

Our mission
To reduce the incidence of osteoporosis and osteoporotic fracture

Objectives
- Increase awareness
- Improve prevention and management
- Increase GP understanding
- Lobby federal government
- Fund bone research
The burden of osteoporosis

- 1.2 million Australians have osteoporosis
- 6.3 million Australians have osteopenia
- 1 in 2 post-menopausal women and 1 in 3 men over 60 will have an osteoporotic fracture
- 35% of fracture-related hospital admissions are due to re-fracture (NSW, 2002-2008)
- 4-fold increase in hip fractures expected by 2051
- Approximately 25% of people with a hip fracture die within 12 months


Survival is reduced after any type of fracture, vertebral or non-vertebral, more so in men than women. (Figure reprinted from Center et al1 with permission from Elsevier.)
How do Indigenous populations fare?

- Very little data
- Study from Cairns
- West Australian Database
- International literature review
Aboriginal and Torres Strait Islander origin have a lower incidence of these fractures than might be expected on an overall population basis (may be due to life expectancy) but similar rates on age-standardised data. The female age profile is substantially older than the female non-indigenous osteoporotic fracture group. Indigenous females develop osteoporotic type fractures of the femoral neck at a later age than do non-indigenous females. This may reflect a genetic difference in bone mineral density or a healthy lifestyle in earlier days.
FIGURE 2: Profile of patients admitted to the Cairns Base Hospital for fractured femoral necks between 7 October 1997 and 31 May 2000 (Cape York Residents only. (1), Indigenous females; (2), indigenous males; (3), non-indigenous females; (4), non-indigenous males.

The age-standardised hip fracture rate was 273.0 (95% confidence interval (CI) 230.7–315.4) per 100 000 person-years for indigenous adults and 148.8 (95% CI 146.1–151.5) per 100 000 person-years for non-indigenous adults.

The standardised morbidity ratio was 2.2 (95% CI 1.9–2.5).

Age standardised rates increased by an average of 7.2% per year among indigenous adults ($P = 0.006$), whereas non-indigenous rates fell by an average of 3.4% per year ($P < 0.001$) (Mainly younger age groups).
Age-standardised rate per 100 000 person-years (indigenous vs non Indigenous)

Y. Y. E. Wong, L. Flicker, G. Draper, M. M. Y. Lai and N. Waldron
Age-specific rate per 100 000 person-years

Figure 2 Age-specific minimal trauma hip fracture rates in Indigenous and non-Indigenous Western Australians, 1999–2009. ( ), Indigenous males; ( ), non-indigenous males; ( ), indigenous females; ( ), nonindigenous females.

Wong et al
Fractures in indigenous compared to non-indigenous populations: A systematic review of rates and aetiology

Differences in hip fracture rates continent-specific

- **lower rates** observed for indigenous persons in all countries **except for Canada and Australia** where the opposite was observed

- Adjustment for socio-demographic and clinical risk factors, approximately a **three-fold greater risk of osteoporotic fracture** and five-fold greater risk of craniofacial fractures was observed for indigenous compared to non-indigenous persons

- **diabetes**, substance abuse, **comorbidity**, lower **income**, locality, and fracture history were independently associated with an increased risk of fracture.
Fractures in indigenous compared to non-indigenous populations: A systematic review of rates and aetiology

Bone Reports: Sharon L. Brennan-Olsen et al http://dx.doi.org/10.1016/j.bonr.2017.04.003
Risk factors for osteoporosis – triggers for GP investigation in the over 50s

- Low trauma fracture fracture/suspected spinal fracture*
- Family history
- Premature menopause*
- ≥ 3 months corticosteroids (≥7.5mg/day)*
- Hypogonadism*
- Primary hyperparathyroidism/hyperthyroidism*
- Aromatase inhibitors
- Rheumatoid arthritis*
- Coeliac disease*
- Chronic kidney or liver disease*
- Recurrent falls
- Over 70 years of age*
- Diabetes

*Medicare rebate available for DXA scan
Goals of osteoporosis management

Tackling osteoporosis management in primary care on three fronts

1. **Identify osteoporosis**
   - Prevent first fracture in at-risk patients

2. **Stop re-fracture**
   - Manage osteoporosis to prevent subsequent fractures

3. **Prevent falls and fractures**
   - Lifestyle management to reduce the risk

Jeff asked for this picture to be changed to a hip or a distal radius??
Haffenden, Sally, 9/04/2014
Diagnosis and treatment

Over 50 with risk factors
- DXA scan
- Treat if T-score ≤ -2.5

Over 50 with minimal trauma fracture
- DXA scan (baseline T-score)
- Treat

All people with osteoporosis should be treated, regardless of PBS eligibility

All people with a minimal trauma fracture and osteopenia should be treated, regardless of PBS eligibility
Figure. Guidelines for the management of osteoporosis risk in older people (70 years and older).  
* There is only evidence to date for fracture prevention with antiresorptive agents in patients with low bone density on densitometry. 
PBS-subsidised antiresorptive agents in patients with minimal trauma require radiological demonstration of the fracture. Raloxifene is PBS listed only for postmenopausal women. Bisphosphonates include risedronate, alendronate or zoledronic acid.
Key issues – the ‘fracture cascade’

Only 20% of MTFs presenting in hospital are investigated for osteoporosis
50-75% of vertebral fractures don’t come to medical attention
Diagnosis and treatment opportunities missed
2-4 fold increase in risk of further low trauma fracture
Increased risk of more severe fractures

Patients with a history of MTF at any site should be investigated for osteoporosis and fracture risk
Fractures at any site increase the risk of further fractures

Original Vertebral Fracture

- Risk of Later any
- Risk of Later non-vert
- Risk of Later hip

Original Non-vertebral Fracture

- Risk of Later any
- Risk of Later vertebral
- Risk of Later hip

Original Hip Fracture

- Risk of Later any
- Risk of Later vertebral
- Risk of Later non-vert

Original Any Type Fracture

- Risk of Later any
- Risk of Later vertebral
- Risk of Later non-vert
- Risk of Later hip

Women aged 65-74 years
Fracture risk is greatest immediately after a fracture

Time course of fracture risk in women aged 60 years following a vertebral fracture requiring hospitalisation compared with the general population. Minimal-trauma vertebral fractures are defined as those occurring from a standing height or less, or from lifting.

Assessing fracture risk

FRAX® WHO fracture risk assessment tool
— www.shef.ac.uk/FRAX/

Garvan Institute Fracture Risk Calculator
— www.fractureriskcalculator.com
Key issues - prevention

‘A paediatric disease with geriatric consequences’
MJA 2013; Vol 2, Supp 1

Objectives:

- Maximise peak bone mass in childhood and adolescence
- Prevent bone loss and maintain muscle strength in adults
- Treat osteoporosis, manage osteopenia and prevent falls in older people

Recommendations for all stages of life:

- Daily dietary calcium intake adequate for age/sex
- Serum vitamin D above 50nmol/L
- Regular weight bearing exercise
Calcium

Recommended adult daily dietary calcium intakes:
- Adults (19-50) 1000mg
- Women over 50, men over 70 1300mg
- People with osteoporosis/osteopenia 1300mg

Supplementation recommended when:
- Dietary intake is insufficient
- Taking osteoporosis medication
- Glucocorticoids ≥ 7.5mg/day for ≥ 3 months
- Elderly, housebound, in residential care

500-600mg per day – combine with vitamin D supplement if required

Building healthy bones throughout life, MJA 2013; 2, Supp 1
Vitamin D

Groups at high risk of deficiency (test end winter/early spring):
  - Housebound/residential care, disabled, **chronically ill**, obese
  - **Darker skin**
  - Sun avoiders/indoor workers
  - Cover skin for cultural/religious reasons
  - On medications that interfere with vitamin D metabolism

<table>
<thead>
<tr>
<th>25-OHD level (nmol/L)</th>
<th>Daily Supplement (IU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-49 (mild deficiency)</td>
<td>1000-2000</td>
</tr>
<tr>
<td>12.5-29 (moderate deficiency)</td>
<td>3000-5000*</td>
</tr>
<tr>
<td>&lt;12.5 (severe deficiency)</td>
<td>3000-5000*</td>
</tr>
</tbody>
</table>

*6-12 weeks, followed by maintenance dose of 1000-2000IU

*Vitamin D position statement, MJA 2012;196:1-7*
Treatment options

- Bisphosphonates
- Denosumab
- Raloxifene
- Teriparatide (second line)

Reduce fracture risk by 30-60%
Effective and generally well tolerated
Choice if side effects/tolerability an issue
### PBS reimbursed anti-osteoporotic therapy options

<table>
<thead>
<tr>
<th>Drug</th>
<th>Treat to prevent first fracture (aged ≥70 years, BMD T-score ≤–2.5)</th>
<th>Treat to prevent second fracture (any age with minimal trauma fracture)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bisphosphonates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alendronate</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Risedronate</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Zoledronic acid</td>
<td>✓ (T-score ≤–3.0)</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Monoclonal antibody</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strontium ranelate</td>
<td>–</td>
<td>✓</td>
</tr>
<tr>
<td>Denosumab</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>SERM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raloxifene</td>
<td>–</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Parathyroid hormone</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teriparatide</td>
<td>–</td>
<td>✓†</td>
</tr>
</tbody>
</table>

*Established osteoporosis in post-menopausal women only.
†Patient must be at very high risk of fracture, BMD T-score ≤–3.0, must have two or more fractures due to minimal trauma, must have experienced at least one symptomatic new fracture after at least 12 months continuous therapy with an anti-resorptive agent. SERM, selective oestrogen receptor modulator.

### Time to onset in Fracture Reduction with current anti-osteoporosis treatments

Adapted from Inderjeeth et al JBMM 2012, Cummings et al NEJM 2009, Papapoulos et al JBMR 2012

<table>
<thead>
<tr>
<th>Agent</th>
<th>Vertebral months</th>
<th>Non-vertebral months</th>
<th>HIP months</th>
<th>Any Clinical Fracture months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risedronate</td>
<td>6</td>
<td>6</td>
<td>(6)/12</td>
<td>6</td>
</tr>
<tr>
<td>Alendronate</td>
<td>6</td>
<td>12</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>Strontium R</td>
<td>12</td>
<td>12</td>
<td>36</td>
<td>12</td>
</tr>
<tr>
<td>Zoled Acid</td>
<td>12</td>
<td>24</td>
<td>36</td>
<td>12</td>
</tr>
<tr>
<td>Denosumab</td>
<td>12</td>
<td>36</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Raloxifene</td>
<td>3 (120mg)</td>
<td>36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ibandronate</td>
<td>12</td>
<td>36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fracture risk in patients with ≤ 50% persistence is the same as in patients who take no medication at all.

Based on a study of 35,537 patients from two US claims databases. Note: Databases are not designed to follow-up persistence with treatment; they do not confirm that patients take the medication, and data can be inaccurate.

*MPR measures refill compliance: the percentage of time a medication was available. MPR, medication possession ratio.

Match treatment to patient characteristics to improve **adherence** = **compliance + persistence**

### Table 3. Dosing for the available forms of osteoporosis treatment

<table>
<thead>
<tr>
<th>Drug</th>
<th>Oral dosing</th>
<th>Intravenous (annual)</th>
<th>Subcutaneous</th>
<th>Special formulations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td>Weekly</td>
<td>Monthly</td>
<td></td>
</tr>
<tr>
<td>Alendronate</td>
<td>5 and 10 mg*</td>
<td>35 and 70 mg*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risedronate</td>
<td>5 mg*</td>
<td>35 mg*</td>
<td>150 mg*</td>
<td>35 mg weekly EC formulation (does not require fasting)</td>
</tr>
<tr>
<td>Raloxifene</td>
<td>60 mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoledronic acid</td>
<td></td>
<td></td>
<td>5 mg</td>
<td></td>
</tr>
<tr>
<td>Denosumab</td>
<td></td>
<td></td>
<td>60 mg (six monthly)</td>
<td></td>
</tr>
<tr>
<td>Strontium ranelate</td>
<td>2 g*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teriparatide</td>
<td></td>
<td></td>
<td></td>
<td>20 µg (daily)*</td>
</tr>
</tbody>
</table>

* Empty stomach and fasting required (see product information for more details); † Lifetime duration of treatment less than or equal to 18 months.
**HYPOCALCAEMIA**

Is it safe to use antiresorptives in patients with CKD?

<table>
<thead>
<tr>
<th>BRAND (drug)</th>
<th>CKD STAGE (GFR mL/min/1.73m²)</th>
<th>PRECAUTIONS IN PATIENTS WITH RENAL IMPAIRMENT¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STAGE 1* (&lt;110)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STAGE 2* (60–90)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STAGE 3 (30–60)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STAGE 4 (15–30)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STAGE 5/D (&lt;15)†</td>
<td></td>
</tr>
<tr>
<td>(alendronate)²</td>
<td>✓</td>
<td>Not recommended if CrCl &lt; 35 mL/min</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>- Contraindicated in hypocalcaemia</td>
</tr>
<tr>
<td>(risedronate)³</td>
<td>✓</td>
<td>Not recommended if CrCl &lt; 30 mL/min</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>- Contraindicated in hypocalcaemia</td>
</tr>
<tr>
<td>(zoledronic acid)⁴</td>
<td>✓</td>
<td>Ensure adequate hydration prior to administration</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>- Not recommended if CrCl &lt; 35 mL/min</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>- Contraindicated in hypocalcaemia</td>
</tr>
<tr>
<td>(denosumab)⁶</td>
<td>✓</td>
<td>CrCl &lt; 30 mL/min risk of hypocalcaemia</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>- Contraindicated in hypocalcaemia</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>- Avoid in adynamic bone disease</td>
</tr>
</tbody>
</table>

“Renal bone disease is an important consequence of chronic kidney disease.”³
“Early referral to a nephrologist to guide monitoring and treatment is recommended.”³

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*Stage 1 & 2: with evidence of intrinsic renal damage (e.g. proteinuria). †Stage 5: <15 mL/min/1.73m² or on dialysis.

HYPOCALCAEMIA

How can it be avoided?

Inhibition of bone resorption may produce a transient period of hypocalcaemia

- With sufficient dietary calcium intake and appropriate vitamin D levels, compensatory mechanisms restore calcium levels

Impaired calcium / vitamin D utilisation can potentially lead to more severe hypocalcaemia after antiresorptives

- Hypocalcaemia must be corrected prior to initiating antiresorptive therapy
- To reduce the risk of hypocalcaemia, patients must be adequately supplemented with calcium and vitamin D during treatment
- Higher doses of supplements may be required in those with malabsorption

Daily requirements

<table>
<thead>
<tr>
<th>CALCIUM</th>
<th>Age</th>
<th>Daily needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>19+</td>
<td>1,000 mg</td>
</tr>
<tr>
<td>Men</td>
<td>50+</td>
<td>1,300 mg</td>
</tr>
<tr>
<td>Woman</td>
<td>70+</td>
<td>1,300 mg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VITAMIN D</th>
<th>Age</th>
<th>Daily needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>51–69</td>
<td>400 IU</td>
</tr>
<tr>
<td></td>
<td>70+</td>
<td>600 IU</td>
</tr>
</tbody>
</table>

Supplementation recommendations

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Supplement daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>1000 mg</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>400 IU</td>
</tr>
</tbody>
</table>

## Long-term anti-resorptive treatment: What are some things to consider? **Drugs differ**

<table>
<thead>
<tr>
<th>Consider</th>
<th>Supporting evidence</th>
<th>Bisphosphonates</th>
<th>Denosumab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What are the long-term risks?</strong></td>
<td>Long-term data</td>
<td>AE profile at 5–10 years shows no significant difference in AEs from placebo&lt;sup&gt;1&lt;/sup&gt;–&lt;sup&gt;5&lt;/sup&gt;</td>
<td>AE profile through to 8 years similar to that seen in the initial pivotal trial versus placebo&lt;sup&gt;6&lt;/sup&gt;,&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Reversibility</strong></td>
<td></td>
<td>Residual effect; depends on type &amp; length of treatment&lt;sup&gt;8&lt;/sup&gt;</td>
<td>Fully reversible&lt;sup&gt;6&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>What happens if my patient stops therapy?</strong></td>
<td>Duration of action</td>
<td>Slow offset of action&lt;sup&gt;8&lt;/sup&gt;</td>
<td>Relatively rapid offset of action&lt;sup&gt;6&lt;/sup&gt;,&lt;sup&gt;8&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Clearance</td>
<td>Renal; detectable in urine weeks, months or years after stopping&lt;sup&gt;8&lt;/sup&gt;</td>
<td>Catabolised in reticuloendothelial system&lt;sup&gt;6&lt;/sup&gt;; almost fully cleared by 6 months&lt;sup&gt;10&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

AE, adverse event; BP, bisphosphonate.

Considerations for suspending bisphosphonate treatment *(NB Different for Denosumab – fully reversible)*

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>Recommendation</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High risk</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>— T-score still ≤ −2.5 at the hip, previous fracture of the hip or spine</td>
<td>— Suspending treatment not justified</td>
<td>— Reassess the ongoing need for therapy at regular intervals</td>
</tr>
<tr>
<td>— Ongoing high-dose glucocorticoid therapy</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Moderate risk</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>— Hip bone T-score &gt; −2.5</td>
<td>— Consider suspending treatment after 3–5 years of alendronate, risedronate or zoledronic acid therapy</td>
<td>— Individual, informed choice with discussion of the potential benefits and risks</td>
</tr>
<tr>
<td>— No prior hip or spine fracture</td>
<td>— Restart when indications for therapy are met</td>
<td></td>
</tr>
</tbody>
</table>

Bisphosphonate Treatment: Report of a Task Force of ASBMR

Approach for Management of Postmenopausal Women on Long Term Bisphosphonate Therapy

Post-menopausal women treated with oral (≥ 5 yrs) or IV (≥ 3 yrs) BPs

Hip, spine or multiple other osteoporotic fractures before or during therapy

Yes

Reassess benefits/risks
Consider continue BP (1) or change to alternative therapy (2)
Reassess every 2-3 years

No

Hip BMD T-Score ≤ -2.5 (3)
OR
high fracture risk (4)

Yes

Reassess benefits/risks
Consider continue BP for up to 10 yrs (1)
or change to alternative therapy (2)
Reassess every 2-3 years

No

Consider drug holiday
Reassess every 2-3 years (2)

Adler RA et al., J Bone Miner Res 2016
What is the "real world" risk of ONJ and atypical fractures?

- Denosumab-AFF
- Bis-ONJ
- Death by murder
- Bis-AFF (2y)
- Denosumab-ONJ
- Fatal MVA
- Bis-AFF (8y)

Major osteoporotic fracture in low-risk women
Major osteoporotic fracture in moderate-risk women
Major osteoporotic fracture in high-risk women

Incidence per 100,000 patient years:

- 650
- 1,600
- 3,100
Risk of Death with Zoledronic Acid

Hazard ratio, 0.72 (95% CI, 0.56–0.93)
P=0.01

Cumulative Incidence (%)

Month

No. at Risk
Zoledronic acid 1054 1029 987 943 806 674 507 348 237 144
Placebo 1057 1028 993 945 804 681 511 364 236 149

Triad of OP fracture risk management

- Osteoporosis (Bone quality)
- Fall (precipitating event)
- Interface (barrier between bone and surface)
Falls risk management

- Vitamin D
- Intrinsic factors eg medical/medications
- Extrinsic factors eg environmental
- Muscle strength
- Balance
- Interface – Hip protectors
Exercise

**Healthy adults:** at least 30 minutes, 3-5 times per week

- *Weight bearing* – running, aerobics, dancing, tennis, netball, basketball, stair climbing
- *Resistance* - hand and ankle weights, gym equipment

**People with osteoporosis:** 3 times per week, supervised

- Weight bearing and progressive resistance training
- Challenging mobility and balance exercises
- Avoid forward flexion and twisting of the spine

*Building healthy bones throughout life. MJA 2013; 2, Supp 1*
To put it all together
Common Links – Disease, Inflammation
Dementia & OP

Positive Factors
- Genetics
- Oestrogen
- Exercise
- Vitamin D
- Nutrition
- statins
- NSAIDS
- AChEI

Negative Factors
- Klotho mutations
- Inflammaging
  - CRP
  - IL6
  - IL 1β
  - TNF α
- COX 1 & 2
- Oestrogen deficiency
- Hyper PTH

Dementia
- Osteoporosis
  - Falls
    - Fractures
    - Mortality

• Genetics • Oestrogen • Exercise • Vitamin D • Nutrition • statins • NSAIDS • AChEI

• Klotho mutations • Inflammaging
  • CRP
  • IL6
  • IL 1β
  • TNF α
  • COX 1 & 2
  • Oestrogen deficiency
  • Hyper PTH
Resources for General Practitioners

GP snapshot

GP kit

osteoporosis.org.au
(health professional section, GP page)
Resources for patients

osteoporosis.org.au
(About osteoporosis-information to download)
Resources for healthy adults

www.healthybonesaustralia.org.au
Thank You

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www.health.wa.gov.au
Table 1. WHO and the International Osteoporosis Foundation DEXA assessment diagnostic categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Hip bone mineral density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>T-score ≥ -1</td>
</tr>
<tr>
<td>Low bone mass (osteopenia)</td>
<td>T-score between &lt; -1 and &gt; -2.5</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>T-score ≤ -2.5</td>
</tr>
<tr>
<td>Severe osteoporosis (established osteoporosis)</td>
<td>T-score ≤ -2.5 and presence of at least one fragility fracture</td>
</tr>
</tbody>
</table>

Abbreviations: DEXA = dual energy x-ray absorptiometry; T-score = number of standard deviations below the mean value of the young healthy population.

Risk factors for osteoporosis fractures

<table>
<thead>
<tr>
<th>General population (evidence level 1)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low bone strength (as assessed by dual x-ray absorptiometry or ultrasound)</td>
<td></td>
</tr>
<tr>
<td>Female*</td>
<td></td>
</tr>
<tr>
<td>Older age*</td>
<td></td>
</tr>
<tr>
<td>Maternal history of fracture</td>
<td></td>
</tr>
<tr>
<td>History of previous fractures*</td>
<td></td>
</tr>
<tr>
<td>Being tall at age 25 years</td>
<td></td>
</tr>
<tr>
<td>Previous hyperthyroidism</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
</tr>
<tr>
<td>Psychotropic medication use</td>
<td></td>
</tr>
<tr>
<td>Higher caffeine intake</td>
<td></td>
</tr>
<tr>
<td>Postural instability*</td>
<td></td>
</tr>
</tbody>
</table>

Institutionalised older persons (in addition to list above; evidence level III-2)

<table>
<thead>
<tr>
<th>Hostels</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male*</td>
<td></td>
</tr>
<tr>
<td>Low serum vitamin D levels*</td>
<td></td>
</tr>
<tr>
<td>Bowel or bladder incontinence *</td>
<td></td>
</tr>
<tr>
<td>Cognitive impairment*</td>
<td></td>
</tr>
<tr>
<td>Poor balance*</td>
<td></td>
</tr>
<tr>
<td>Ambulatory*</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nursing homes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male*</td>
<td></td>
</tr>
<tr>
<td>Low serum vitamin D levels*</td>
<td></td>
</tr>
<tr>
<td>Bowel or bladder incontinence *</td>
<td></td>
</tr>
<tr>
<td>Cognitive impairment*</td>
<td></td>
</tr>
<tr>
<td>Use of anxiolytics*</td>
<td></td>
</tr>
<tr>
<td>High serum phosphate levels*</td>
<td></td>
</tr>
</tbody>
</table>

* High hazard ratio in institutionalised older persons versus community-dwelling individuals.