Assessment of the risk of osteoporotic fractures in 2008

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## Estimated lifetime fracture risk in 50-year-old white women and men

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Women % (95% CI)</th>
<th>Men % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximal femur fracture</td>
<td>17.5 (16.8 - 18.2)</td>
<td>6.0 (5.6 - 6.5)</td>
</tr>
<tr>
<td>Vertebral fracture *</td>
<td>15.6 (14.8 - 16.3)</td>
<td>5.0 (4.6 - 5.4)</td>
</tr>
<tr>
<td>Distal forearm fracture</td>
<td>16.0 (15.2 - 16.7)</td>
<td>2.5 (2.2 - 3.1)</td>
</tr>
<tr>
<td>Any of the three</td>
<td>39.7 (38.7 - 40.6)</td>
<td>13.1 (12.4-13.7)</td>
</tr>
</tbody>
</table>

* Using incidence of clinically diagnosed fractures only

Melton et al.; JBMR 1992
Lifetime risk of hip fracture in women aged 50 years

Osteoporosis
Osteopenia
Normal

Lifetime risk of hip fracture in women aged 50 years

Femoral neck BMD (g/cm²)

T-score (SD)

LTR (%)
Patient screening

- The **diagnosis** of osteoporosis is based on bone mass measurement (T score < -2.5 SD).
- However, the risk of osteoporotic fracture is multifactorial (function of bone mass AND other risk factors).
- Using only bone mass measurement as a screening tool is not optimal (the test is not sensitive enough).
Fracture risk is a gradient, NOT a threshold


Relative risk of hip fracture vs. Age-adjusted SD score at femoral neck
FRAX model

FRAX is an algorithm to assess absolute fracture risk

It is a mega-analysis (almost 250,000 subject years) from 9 populations based cohorts

It quantifies risk factors that have been used qualitatively for years

Allows to

* find individuals at high risk of fractures from a population at modest risk (osteopenia)
* reduce chance of inappropriate treatment
FRAX: Cohorts studied

EVOS / EPOS  Hiroshima  CaMoS
Rochester  Sheffield  Rotterdam
Kuopio  Gothenburg I  Gothenberg II
EPIDOS  Dubbo  OFELY

n = 59,232  person-years = 249,898  % female = 74

Any fracture = 5,444  osteoporotic fractures = 3,495  hip fractures = 957
Risk factors in WHO predictive model

- Age
- Sex
- Femoral neck BMD
- Prior fragility fracture after age 50\(^1\)
- Body mass index
- Ever use of corticosteroids
- Secondary osteoporosis (e.g., rheumatoid arthritis)
- Parental history of hip fracture
- Current cigarette smoking
- Alcohol intake > 2 units/day

\(^1\)hip, spine, distal forearm, proximal humerus, pelvis, ribs, proximal tibia in women
Chronic alcohol / tobacco abuse is detrimental to bone health, with one of the mechanisms being a direct toxic effect on bone forming cells.
FRAX (Fracture Risk Assessment X)
http://www.shef.ac.uk/FRAX/tool.jsp?locationValue=12

Calculation Tool

Please answer the questions below to calculate the ten year probability of fracture with BMD.

Country: Sweden

Weight Conversion: pound: [input]
Height Conversion: inch: [input]

Questionnaire:

1. Age (between 40-90 years) or Date of birth
   Age: [input]
   Date of birth: [input]

2. Sex
   Male ☐ Female ☐

3. Weight (kg): [input]

4. Height (cm): [163]

5. Previous fracture
   No ☐ Yes ☐

6. Parent fractured hip
   No ☐ Yes ☐

7. Current smoking
   No ☐ Yes ☐

8. Glucocorticoids
   No ☐ Yes ☐

9. Rheumatoid arthritis
   No ☐ Yes ☐

10. Secondary osteoporosis
    No ☐ Yes ☐

11. Alcohol 3 more units per day
    No ☐ Yes ☐

12. Femoral neck BMD
    T-score: [-2.8]

BMI: 31.2
The ten year probability of fracture (%) with BMD
- Major osteoporotic: 49
- Hip fracture: 40

Risk factors
FRAX (Fracture Risk Assessment X)

Please answer the questions below to calculate the ten year probability of fracture with BMD.

**Questionnaire:**
1. Age (between 40-90 years) or Date of birth:
   - Age: 75
   - Date of birth: Y: [ ] M: [ ] D: [ ]

2. Sex:
   - Male
   - Female

3. Weight (kg): 83
4. Height (cm): 183
5. Previous fracture:
   - No
   - Yes
6. Parent fractured hip:
   - No
   - Yes
7. Current smoking:
   - No
   - Yes
8. Glucocorticoids:
   - No
   - Yes
9. Rheumatoid arthritis:
   - No
   - Yes
10. Secondary osteoporosis:
    - No
    - Yes
11. Alcohol 3 more units per day:
    - No
    - Yes
12. Femoral neck BMD:
    - T-score: -2.8

**The ten year probability of fracture (%)**
- Major osteoporotic: 31
- Hip fracture: 24
Risk factors for osteoporotic fractures (HIP)

Remaining significant after adjustment for bone mass:

* AGE
* HISTORY OF NONTRAUMATIC FRACTURE
  any fracture after 50 years → ↑ RR to 1.62
* FAMILIAL HISTORY FOR HIP FRACTURE (mother or father) → ↑ RR to 2.28
* BMI < 20 → ↑ RR to 1.42
* CORTICOSTEROID USE → ↑ RR to 2.25
* TABAGISM → ↑ RR to 1.60
* ALCOHOL (> 2 glasses/day) → ↑ RR to 1.70

+ tendency to fall, early menopause, sedentarity,...
Most Osteoporotic Fractures Occur in a Fall

Risk Factors for Falls
- Muscle weakness
- Poor balance
- Poor eyesight
- Benzodiazepine use
- Poor overall health

Risks for Fracture in a Fall
- Failure to break a fall
- Falling to the side
- Age
- Low bone mass
- Unfavorable bone geometry
- High bone turnover
Prediction of absolute risk of fracture by validation of risk factors in a Belgian cohort followed during 10 years

FRISBEE
(Fractures Risk Study Brussels Epidemiological Enquiry)
<table>
<thead>
<tr>
<th>investigators</th>
<th>sponsors</th>
</tr>
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<tbody>
<tr>
<td>CHU Brugmann</td>
<td>IRIS-RECHERCHE</td>
</tr>
<tr>
<td>JJ Body</td>
<td>Merck Sharp &amp; Dohme</td>
</tr>
<tr>
<td>P. Bergmann</td>
<td>Roche</td>
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<tr>
<td>A. Peretz</td>
<td>Procter &amp; Gamble</td>
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<tr>
<td>CHU St-Pierre</td>
<td>Novartis</td>
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<tr>
<td>S. Rozenberg</td>
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<td>M. Tondeur</td>
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<td>IRIS Sud</td>
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<td>A. Mindlin</td>
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<td>M. Rubinstein</td>
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<td>Inst. J. Bordet</td>
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<td>M. Paesmans</td>
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<td>M. Moreau</td>
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<td>A. Grivegnée</td>
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<td>GPs</td>
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<td>JM Thomas</td>
<td></td>
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<td>M. Roland</td>
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</tbody>
</table>
Objectives

• Determine the absolute risk fracture (%) at 5 and 10 years (establishment of a risk model)

• Determine the relative importance of risk factors in a Belgian population.
Methodology

- Prospective study
- Population: women 60 – 80 years old selected from population lists of 6 communes in Brussels
- Target: 5000 (800 screened as of today)
- Yearly phone calls (fractures, serious diseases, started / changed osteoporosis therapy)
Methodology

• Explanatory variables collected during the interview
  - Age
  - History of hip fracture (mother, father)
  - Personal history of fracture after 50 years
  - Diseases known to be a cause of secondary osteoporosis
  - BMI < 20
  - History of corticosteroid use
  - Tabagism
  - Excessive alcohol consumption
Methodology

- Other explanatory variables collected during the interview
  - Physical activity (sedentarity)
  - Menopause < 45 years
  - Fall tendency
  - Use of sleeping pills
  - Ethnic origin
  - Veil wearing
  - Hormone replacement therapy
  - Osteoporosis treatment (bisphosphonates, …)
  - Supplements of calcium / Vit D
Methodology

• Explanatory variables collected during the visit
  ➢ Measure of bone mineral density (DXA)
Methodology

- Response variables
  - Fractures (validated)
  - yearly telephone contact