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**Australian Institute of  
Health and Welfare**

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*Authoritative information and statistics  
to promote better health and wellbeing*

# **Estimating the prevalence of osteoporosis in Australia**

Australian Institute of Health and Welfare  
Canberra

Cat. no. PHE 178

**The Australian Institute of Health and Welfare is a major national agency which provides reliable, regular and relevant information and statistics on Australia's health and welfare. The Institute's mission is authoritative information and statistics to promote better health and wellbeing.**

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ISBN 978-1-74249-627-6

### **Suggested citation**

Australian Institute of Health and Welfare 2014. Estimating the prevalence of osteoporosis. Cat. no. PHE 178. Canberra: AIHW.

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Published by the Australian Institute of Health and Welfare

This publication is printed in accordance with ISO 14001 (Environmental Management Systems) and ISO 9001 (Quality Management Systems). The paper is sourced from sustainably managed certified forests.



**Please note that there is the potential for minor revisions of data in this report. Please check the online version at <[www.aihw.gov.au](http://www.aihw.gov.au)> for any amendments.**

# Acknowledgments

This report was authored by Alice Crisp, Lucas Mills and Louise York from the Australian Institute of Health and Welfare and reviewed by Lisa McGlynn, Geoff Neideck and David Whitelaw from the AIHW.

We are grateful for comments from two external reviewers, Kerrie Sanders and Jian Sheng Chen, and for the cooperation of the five epidemiological studies presented in Chapter 3, including supply of requested data.

The report was prepared under the guidance of the Arthritis and Other Musculoskeletal Conditions Advisory Group whose members are: Lyn March (Chair), Flavia Cicuttini, Robert Cumming, Peter Ebeling, Ann Taylor, Pam Webster, Mellick Chehade, Chris Maher, Paul Hodges and Tania Winzenberg.

The project was funded by the Australian Government Department of Health.

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# Abbreviations

ABS	Australian Bureau of Statistics
ACFI	Aged Care Funding Instrument
AHS	Australian Health Survey
AIHW	Australian Institute of Health and Welfare
BMD	bone mineral density
DEXA	dual energy X-ray absorptiometry
NHMD	National Hospital Morbidity Database
NHS	National Health Survey
NNPAS	National Nutrition and Physical Activity Survey

# Summary

Osteoporosis, a common condition among older people, causes bones to become weak. Until a minimal trauma fracture occurs, osteoporosis has no obvious symptoms and so many cases go undiagnosed. Therefore, it is difficult to determine the true prevalence of the condition (that is, the number of people with the condition).

This report presents information about the prevalence and impact of osteoporosis in Australia using data gathered for Australian men and women aged 50 and over.

No single source of information was found to provide definitive prevalence estimates of osteoporosis in Australia. Collectively, the data show broadly similar patterns of osteoporosis prevalence in the self-reported national surveys and smaller epidemiological studies. The prevalence of osteoporosis increased markedly with increasing age and was higher in women than in men in each age group.

## Prevalence of osteoporosis

- In 2011–12 the estimated prevalence of self-reported diagnosed osteoporosis among those aged 50 and over living in the community was 15% of women and 3% of men, according to the Australian Health Survey.
- Based on a recent study measuring bone density in a population sample, the prevalence of osteoporosis among those aged 50 and over was estimated to be 23% of women and 6% of men. This estimate includes both diagnosed and undiagnosed cases of osteoporosis.
- Osteoporosis is listed as a significant health factor affecting the care needs in 12% of people receiving permanent residential aged care. This is likely to be an underestimate because other studies show 21% of people aged over 80 have diagnosed osteoporosis and also due to limitations with the data source for this purpose.

## Impact of osteoporosis

- Osteoporosis is one of several risk factors for minimal trauma fracture. While not all minimal trauma fractures occur in people with osteoporosis, fracture risk is higher for those with the condition. Fracture statistics, therefore, provide insight into the impact of osteoporosis and the benefits of its prevention.
- Minimal trauma fractures are relatively common in people aged 50 and over. It is estimated that, for Australians aged 50 and over, 1 in 4 men and 2 in 5 women will experience a minimal trauma fracture in the future.
- Minimal trauma fracture of the hip is one of the most serious outcomes of osteoporosis. In 2011–12, 19,000 people aged 50 and over were hospitalised due to a minimal trauma hip fracture, of whom 71% were aged 80 and over and 72% were women.
- Although the rate of minimal trauma hip fracture for people aged 50 and over has decreased over time (age-adjusted), the actual number of hip fractures continues to increase due to the increasing number of older adults in Australia.



# 1 Introduction

Osteoporosis is a systemic skeletal condition that causes bones to become thin, weak and fragile, such that even a minor bump or accident can cause a fracture (broken bone). While osteoporosis can occur at any age, bone loss generally occurs over a long period of time and so older people, particularly post-menopausal women, are at greater risk of having this condition. With an ageing population, an increasing number of Australians, particularly those aged over 50, are at risk of developing osteoporosis and sustaining a fracture.

Fractures can cause significant pain, disability and reduced quality of life. All major types of fracture are associated with an increased risk of premature death (Bliuc et al. 2013).

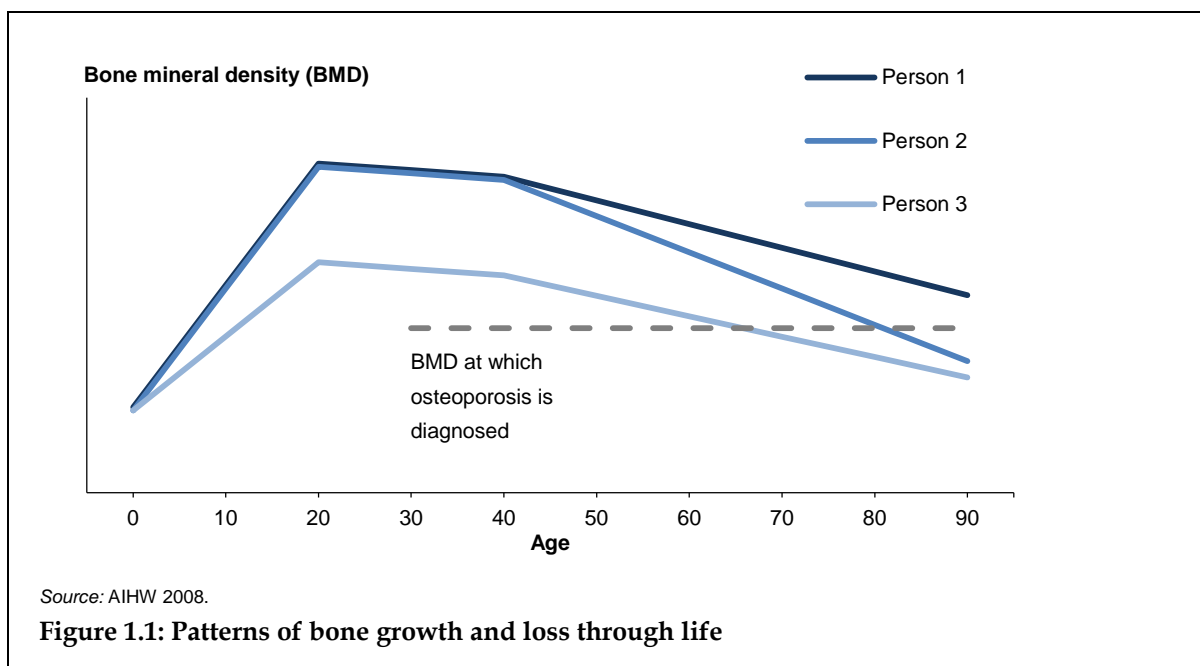
In terms of economic impact, the direct health-care expenditure on osteoporosis in 2008–09 was conservatively estimated to be \$306 million in 2008–09 (AIHW 2014). A study conducted by Osteoporosis Australia, using a much broader methodology, estimated the direct and indirect costs of osteoporosis in Australia at \$2,754 million in 2012 (Watts et al. 2013).

## **Box 1.1: Bone development and loss**

The likelihood that a person develops osteoporosis is related to the way their bones develop and are maintained over the life span. Throughout life, minerals such as calcium and phosphorous are constantly deposited and reabsorbed (broken down) from the bones. This is a normal part of healthy bone growth and maintenance. During the life span, rates of deposition and reabsorption change. Deposition levels are at their highest during childhood and adolescence, when large amounts of bone are formed. Between 20–30 years of age, bone mass has reached its peak. Factors affecting peak bone mass include diet, calcium intake, exercise levels and genetics.

For about the next 20 years of life, bone is reabsorbed at around the same rate as it is deposited, maintaining the skeletal structure. Between 40–50 years of age, the rate of reabsorption increases and bone mass is lost. Various factors can influence the rate of loss, including diet, calcium intake, activity levels and hormonal changes.

Figure 1.1 shows the effects of different patterns of bone growth and loss on the development of osteoporosis. Person 1 represents a person without osteoporosis, who achieves a good peak bone mass and has a modest rate of bone loss with age. Person 2 reaches 'normal' peak bone mass, but has a relatively high rate of bone loss and eventually develops osteoporosis. Person 3 has a 'normal' rate of bone loss, but reaches the osteoporotic level due to her relatively low peak bone mass.



## Diagnosing osteoporosis

A preliminary diagnosis of osteoporosis may be made after a person has a minimal trauma fracture, that is, a fracture that occurs as a result of a fall from a standing height or less which would not be expected to fracture a healthy bone. Doctors may also investigate patients at risk of having this condition, particularly post-menopausal women, the elderly, those receiving long-term steroidal treatment or those with a family history of osteoporosis.

The condition is formally diagnosed using specialised X-ray equipment, called dual energy X-ray absorptiometry (DEXA), a technique which measures the bone mineral density (BMD) at the hip or spine and provides an assessment a patient's future risk of fracture.

Results are expressed as T-scores (or standard deviations) comparing a person's BMD with the average BMD in young adults (Box 1.2). The World Health Organization (WHO) has developed guidelines, using T-score values to classify people as having normal bone density, low bone density (osteopenia) or severe bone loss (osteoporosis).

BMD testing only captures one aspect of bone fragility. Other problems relating to bone structure can contribute to a higher risk of minimal trauma fracture.

### **Box 1.2: Diagnosing osteoporosis using bone mineral density testing**

The 'gold standard' method for measuring bone mineral density (BMD) is dual-energy X-ray absorptiometry, also known as DXA or DEXA. Low-dose X-ray beams are aimed at the bones, and bone density can be determined from the amount of X-rays that are absorbed.

BMD results can be divided into three categories:

- Normal: BMD less than 1 standard deviation below the average BMD in young adults.
- Osteopenia: BMD between 1 and 2.5 standard deviations below the average BMD in young adults.
- Osteoporosis: BMD more than 2.5 standard deviations below the average BMD in young adults.

*Source:* Kanis & the WHO Study Group (1994).

BMD score and several other factors are used to identify individuals at very high risk of sustaining a minimal trauma fracture who are eligible for government-subsidised medications for osteoporosis (Box 1.3).

### **Box 1.3: Eligibility criteria for government-subsidised osteoporosis medication**

BMD score is used as part of the eligibility criteria for government-subsidised osteoporosis medications in Australia. The criteria for subsidised medications identify those at very high risk of minimal trauma fractures. The criteria state that people aged over 70 are eligible for subsidised osteoporosis medications if they have a BMD score more than 3 standard deviations below average or if they have previously sustained a minimal trauma fracture. In addition, people aged over 70 are eligible for subsidies for risedronate if they are on long-term corticosteroid therapy (a risk factor for osteoporosis) and have a BMD score more than 1 standard deviation below average (Department of Health 2014).

For further information on the use of osteoporosis medications in Australia see AIHW 2011.

## **Estimating the prevalence of a 'silent' condition**

Previous Australian Institute of Health and Welfare (AIHW) reports on osteoporosis have relied on self-reported information from Australian Bureau of Statistics (ABS) National Health Surveys, where people are asked if they have ever been diagnosed by a doctor or nurse as having this condition (see, for example, AIHW 2011). These and other reports note the difficulties in estimating the prevalence of osteoporosis (that is, the number or proportion of a population with the condition) because for many people it can be a 'silent' condition with no overt symptoms and therefore remains undiagnosed. The true prevalence of osteoporosis in the community is therefore comprised of a combination of 'diagnosed' and 'undiagnosed' cases.

People at risk of having osteoporosis, or those who have suffered a clinical fracture (that is, one where medical attention was sought), may be investigated and found to have osteoporosis. These 'diagnosed' people are able to accurately report their status when asked and are captured in data sources (such as the National Health Surveys or the National Hospital Morbidity Database) previously presented in AIHW reports on osteoporosis.

A further proportion of the population have reduced bone density, but have not yet had a fracture. In addition, osteoporosis may not be diagnosed following a fracture for two reasons: the individual sought no medical attention for the fracture or, following treatment for the fracture, the individual was not investigated for osteoporosis.

These 'undiagnosed' people would not be able to accurately report their status when asked in a population survey. However, epidemiological studies using objective biomedical criteria to assess the bone density of a sample of Australians are able to produce broader estimates that include both the diagnosed and undiagnosed population with osteoporosis. These studies are therefore investigated in this report, along with a range of other data sources to assist in refining our understanding of the prevalence of osteoporosis in the Australian community.

## **Risk factors for osteoporosis and minimal trauma fracture**

A number of modifiable and non-modifiable factors increase the risk of osteoporosis. These include older age, being physically inactive, having a family history of osteoporosis, insufficient calcium intake, smoking, excessive alcohol consumption, long-term steroidal treatment, vitamin D deficiency and (in women) being post-menopausal (Ebeling et al. 2013).

Osteoporosis is a risk factor for minimal trauma fractures. Other risk factors include age, a history of falls or a tendency to fall, low body weight, high bone turnover and a history of minimal trauma fractures (Nguyen et al. 2007, Arden 2006). In addition to BMD testing, these clinical risk factors play an important role in the identification of individuals at risk of minimal trauma fracture. When a BMD scan is not available, the clinical risk factors can be used in isolation to assess the risk of minimal trauma fracture.

Not all individuals who sustain minimal trauma fracture have osteoporosis associated with low BMD (although they may have osteopenia or bone fragility caused by other factors). One Australian study found that, for people aged 60 and over, 26% of men and 45% of women who sustain minimal trauma fractures have osteoporosis associated with low BMD (Nguyen et al. 2007). We do know that fracture risk increases with decreasing BMD – with fracture risk increasing approximately twofold for every one standard deviation decrease in BMD below the mean for a young adult (Edwards et al. 2013).

Avoiding or altering exposure to risk factors form the basis of many prevention strategies. For osteoporosis this includes getting enough calcium and vitamin D, keeping physically active and not smoking. Preventing falls, and preventing re-fractures among those who have already sustained a fracture, is also an important component of fracture prevention strategies, particularly among people who have low bone density. Raising awareness about osteoporosis and its effects, and educating people about how they can reduce their risk, are important components of population-wide prevention strategies.

## **Questions addressed**

This report brings together prevalence estimates of osteoporosis from various sources to synthesise and refine what is known about the prevalence and impact of this condition in Australia. The focus is on Australian men and women aged 50 and over, living in the community or in residential aged-care settings.

As described in the subsequent chapters, no single data source can provide a definitive estimate of the prevalence of osteoporosis in Australia. This report explores differences in osteoporosis prevalence estimates across a number of sources in an effort to answer the following key questions:

- How wide-spread is osteoporosis in men and women aged 50 and over in Australia?
- What do we know about diagnosed osteoporosis and measured osteoporosis (using bone mineral density testing) and what does this tell us about undiagnosed osteoporosis?
- What do we know about the impact of osteoporosis, particularly with respect to hospitalisation for minimal trauma hip fracture?
- What conclusions can be made in light of the above?

## Report structure

This introductory chapter provides an overview of osteoporosis in Australia and outlines the purpose of this report.

Chapter 2 presents estimates of diagnosed osteoporosis using self-reported data from the most recent national population health survey (for the general community) and from residential aged care needs assessments (for the population in permanent residential aged care).

Chapter 3 presents prevalence estimates based on studies that have measured bone density in the population and considers what this may mean in terms of undiagnosed osteoporosis in the Australian community.

Chapter 4 examines the impact of osteoporosis by examining research relating to the lifetime risk of a minimal trauma fracture, and national hospitalisation data on a severe form of minimal trauma fractures, those affecting the hip.

The final chapter discusses the findings of this report.

## 2 Diagnosed osteoporosis

Osteoporosis is commonly diagnosed when a person visits a doctor, clinic or hospital following a minimal trauma fracture, or if they are in a particular risk group.

### Osteoporosis in the community

This section presents findings from the ABS Australian Health Survey (AHS), National Health Survey 2011–12 component (ABS 2012). The survey collects self-reported information from a community sample and is designed to obtain national benchmark information on a wide range of health conditions, lifestyle factors (including exercise and nutrition) and health-related actions, and to monitor changes in these factors over time. Based on information collected from a sample of randomly chosen Australians, these surveys provide nationally representative estimates for the Australian population (Appendix A).

Self-reported data from a community sample have the limitation that they rely on the memory of the respondent, and cannot capture conditions that have not been detected by a medical professional.

For the purposes of this report, when discussing the findings of the AHS, respondents were classified as having osteoporosis if they had ever been told by a doctor or nurse that they had osteoporosis or osteopenia.

Self-reported Australian Health Survey (AHS) data may underestimate the prevalence of osteoporosis for the following reasons:

- in the absence of overt physical symptoms, people who have osteoporosis may be aware they have this condition
- while the diagnosis of osteoporosis tends to occur after a minimal trauma fracture, in some cases osteoporosis may still be undiagnosed and/or untreated
- people who live in hostels and residential aged-care facilities are not included in the AHS, thereby excluding an important population group for this condition.

It is also possible that the survey overestimates the prevalence of osteoporosis for reasons outlined in more detail below (see page 8).

Previous ABS National Health surveys have shown that the proportion of the population with osteoporosis has remained relatively stable between 2004–05 and 2011–12. The age-standardised proportion of all Australians with osteoporosis was 2.9% in 2004–05, 3.2% in 2007–08 and 3.1% in 2011–12 (ABS 2012).

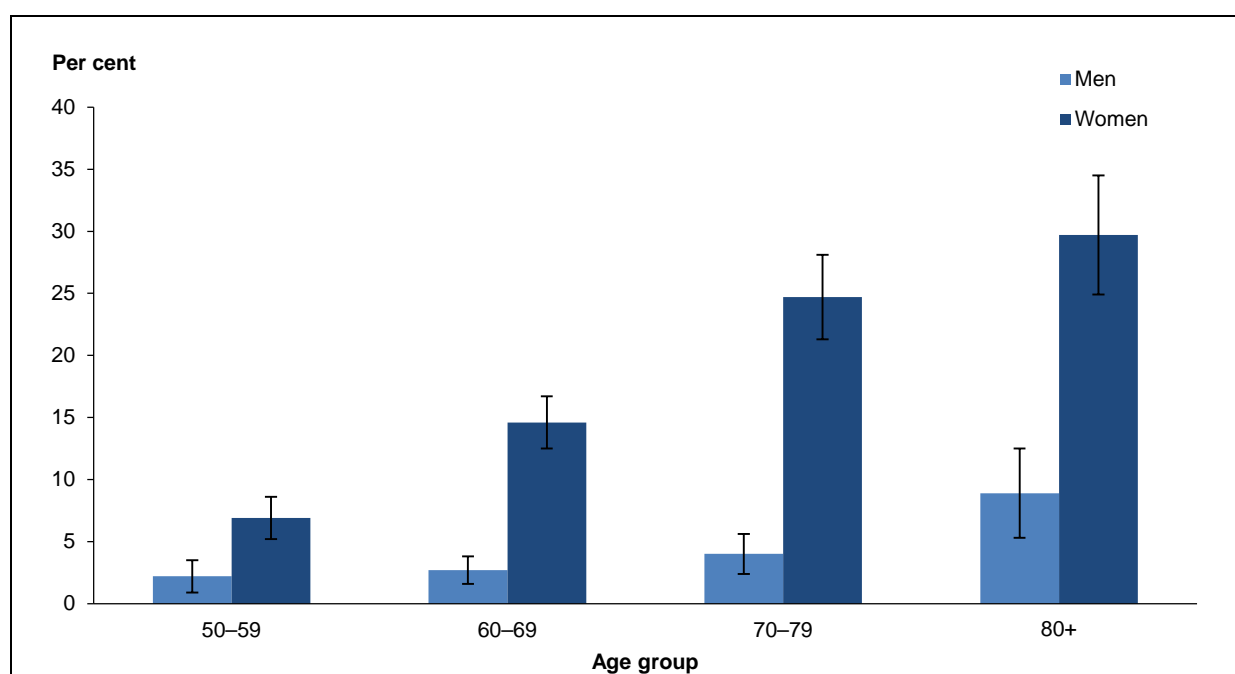
In 2011–12, an estimated 652,500 Australians over the age of 50 (9% of this age group; 3% among men and 15% among women) had been diagnosed with osteoporosis (Table 2.1). The majority of people who reported having osteoporosis were women, accounting for 81% of people with this condition. Osteoporosis also tended to affect older age groups (Figure 2.1). The proportion of women with osteoporosis dramatically increased with age, affecting around 30% of women aged 80 years and over.

While osteoporosis is a condition that is widely recognised as affecting post-menopausal women, the condition also becomes more prevalent in men as they age, affecting 9% of men aged 80 and over.

**Table 2.1: Number and proportion of people aged 50 and over, diagnosed with osteoporosis based on self-reports, by age and sex, 2011–12**

Age group	Men		Women		People	
	%	95% CI	%	95% CI	%	95% CI
50–59	2.2	0.9–3.5	6.9	5.2–8.6	4.6	3.4–5.8
60–69	2.7	1.6–3.8	14.6	12.5–16.7	8.7	7.6–9.8
70–79	4.0	2.4–5.6	24.7	21.3–28.1	14.8	12.6–17.0
80+	8.9	5.3–12.5	29.7	24.9–34.5	20.9	17.5–24.3
<b>Estimated proportion of people aged 50 and over</b>	<b>3.3</b>	<b>2.6–4.0</b>	<b>15.1</b>	<b>13.9–16.3</b>	<b>9.4</b>	<b>8.7–10.1</b>
<b>Estimated number of people aged 50 and over</b>	<b>110,000</b>		<b>542,500</b>		<b>652,500</b>	

Source: ABS unpublished data from Australian Health Survey (National Health Survey 2011–12).



Source: ABS unpublished data from Australian Health Survey (National Health Survey 2011–12).

**Figure 2.1: Self-reported diagnosed osteoporosis by age and sex, 2011–12**

More than 80% of people who reported having osteoporosis noted that they had previously had a bone density test and, of these, the majority (55%) had been conducted in the last two years (Table 2.2). Of those reporting a diagnosis of osteoporosis, 83% of women and 75% of men had previously had a bone density test. Because such a high proportion of those who reported having osteoporosis had previously had a bone density test we can be confident that most respondents correctly understood the relationship between bone density and osteoporosis and were not confusing it with another condition. The remaining proportion may have been diagnosed based on clinical presentation alone.

**Table 2.2: Proportion of people aged 50 and over with osteoporosis who have ever had a bone density test, 2011–12**

	Men	Women	People
	%	%	%
Total ever tested	74.7	83.0	81.6
Within the last two years	58.5	54.0	54.8
Two or more years ago	15.5	28.1	26.0
Not tested	20.7	14.9	15.9
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Note: The percentages shown may not add up to 100%, as the total includes 'not known' and/or 'not stated' responses.

Source: ABS unpublished data from Australian Health Survey (National Health Survey 2011–12).

It is possible, due to the wording of the AHS question, that the survey overestimates diagnosed osteoporosis in the community. Respondents were asked whether they had osteoporosis *or* osteopenia (low bone density) and it is not possible to separate these results. It is important to note that osteopenia is also likely to be under-diagnosed, making it difficult to accurately estimate the true extent of osteopenia based on self-reports.

Self-reported estimates from the Victorian Population Health Survey, which asked respondents whether they had osteoporosis only, produced higher estimates than those reported in the AHS, although most age-group-specific estimates fell within comparable confidence intervals (Table 2.3). This suggests that, although there may be some overestimation in the AHS due to including osteopenia in the osteoporosis prevalence estimates, this is likely to be minimal.

**Table 2.3: Proportion of people aged 50 and over diagnosed with osteoporosis based on self-reports, by age and sex, Victoria, 2011–12**

Age group	Men		Women		People	
	%	95% CI	%	95% CI	%	95% CI
50–59	2.7	1.9–3.7	8.7	7.6–10.0	5.8	5.0–6.6
60–69	4.3	3.4–5.4	16.5	14.9–18.1	10.6	9.6–11.6
70–79	7.5	6.0–9.3	28.6	26.3–31.0	19.0	17.5–20.6
80+	10.4	8.0–13.5	34.4	30.9–38.0	23.8	21.4–26.3
<b>Estimated proportion of people aged 50 and over</b>	<b>4.7</b>	<b>4.1–5.4</b>	<b>17.5</b>	<b>16.6–18.4</b>	<b>11.4</b>	<b>10.8–12.0</b>

Source: Victorian Department of Health, unpublished data from Victorian Population Health Survey, 2011–12.

## Osteoporosis in residential aged care facilities

Residential aged care facilities provide older people with supported care. The sample for the AHS does not include people who live in these settings, and therefore cannot tell the full story about osteoporosis in Australia.

This section examines what is known about osteoporosis in residents of aged care facilities by presenting information about the proportion of aged care residents where osteoporosis has been assessed as one of the main health conditions recorded in the Aged Care Funding Instrument (ACFI). For each resident, up to three health conditions can be recorded in the



ACFI. This tool is used to assess the care needs of residents of aged care facilities, in order to determine the level of funding for the facility. An ACFI appraisal is completed for all new residents of aged care facilities, and updated if their care needs change (AIHW 2013b, Appendix A).

Nearly all permanent residents aged 50 and over with an ACFI appraisal had at least one health condition reported. Of these, 26,300 residents (12%) had osteoporosis recorded as a major medical condition. Women accounted for the majority of these, with 23,500 resident records (16% of female residents) listing osteoporosis, compared with 2,900 men (4% of male residents). These numbers largely reflect the increasing prevalence of osteoporosis with age, the higher prevalence among women than men, and the much larger numbers of older women in care compared with older men (Table 2.4).

**Table 2.4: Permanent aged care residents with a recorded diagnosis of osteoporosis listed as one of the three main factors affecting care needs in an ACFI appraisal, by age and sex, 2010–11**

Age group	Men		Women		People	
	Number	% <sup>(a)</sup>	Number	% <sup>(a)</sup>	Number	% <sup>(a)</sup>
50–59	27	1.7	61	4.5	88	3.0
60–69	126	2.3	345	7.2	471	4.6
70–79	509	3.5	2,164	11.8	2,673	8.1
80+	2,196	4.6	20,884	16.8	23,080	13.5
<b>Residents aged 50 and over</b>	<b>2,858</b>	<b>4.1</b>	<b>23,454</b>	<b>15.8</b>	<b>26,312</b>	<b>12.1</b>

(a) proportion of total in each age–sex group.

Source: AIHW National Aged Care Data Clearinghouse.

ACFI data are likely to underestimate the prevalence of osteoporosis in residents of aged care facilities because medical diagnoses are recorded in order of importance for the resident’s care, with a maximum of three diagnoses recorded. Most residents (90%) have at least three conditions and only the highest-priority conditions affecting care can be incorporated into the resulting database. If there are three diagnoses with a greater impact on the resident’s care needs, then an existing diagnosis of osteoporosis may not be recorded in their ACFI appraisal record.

As with survey data, ACFI data have the limitation that cases of osteoporosis not diagnosed cannot be captured. This will lead to an additional underestimate of osteoporosis prevalence from this data source.

Due to these restrictions, we have avoided describing this as a ‘prevalence estimate’, as there may be significant undercounting. The age-specific proportions of women in residential aged care facilities with this condition (based on an ACFI appraisal) are much lower than community prevalence estimates presented in this report.

### 3 Measured osteoporosis

In this section we examine prevalence estimates from a number of epidemiological studies that have measured bone density in a sample of the population. In contrast to self-reported prevalence estimates, these estimates include cases where the individual is not aware they have the condition.

In Australia, there are a number of epidemiological studies that have measured BMD in population samples around the country. Estimates from one such study, the Geelong Osteoporosis Study (Henry et al. 2011), found that up to 6% of men and 23% of women over the age of 50 have a bone density in the osteoporotic range.

#### Epidemiological studies measuring BMD

Several Australian epidemiological studies were identified for inclusion in this report, based on whether they measured BMD using DEXA at a number of sites of the body and were designed to produce information representative of the specified population. These studies provide objective data on the prevalence of osteoporosis, through the measurement of bone density in the population, for different age and sex groups and at various times over the last several decades (Table 3.1). Such studies provide important evidence about the prevalence of osteoporosis, as they include undiagnosed cases. However, they have smaller sample sizes than the national health survey discussed in the previous chapter.

**Table 3.1: Summary of surveys with measured BMD at the femoral neck**

	Dubbo Osteoporosis Epidemiological Study (DOES)	Geelong Osteoporosis Study (GOS)	Tasmanian Older Adult Cohort Study (TasOAC)	North West Adelaide Health Survey	Concord Health and Ageing in Men Project (CHAMP)
Year					
Men	1989–1990	2001–2006	2002–2004	2004–2006	2006
Women	1989–1990	1993–1997	2002–2004	2004–2006	..
Scope	Community sample of adults aged 60 and over in Dubbo, NSW	Community sample of adults listed on the electoral roll in the Barwon Statistical Division, Victoria	Community sample of adults aged 50–80 listed on the electoral role in Southern Tasmania	Community sample of adults in the north-west region of Adelaide	Community sample of men aged 70 and over listed on the electoral roll in local government areas surrounding Concord hospital, NSW
Sample <sup>(a)</sup>	2,045	1,668	1,091	437	1,662
Participation rate <sup>(b)</sup>	51%	54%	57%	81% <sup>(d)</sup>	54%
Densitometer <sup>(c)</sup>	Lunar	Lunar	Hologic	Lunar	Hologic

.. not applicable

(a) refers to the number of participants with valid measurements of BMD at the femoral neck.

(b) refers to the full number of participants in the study. The number of participants who had valid BMD scans is a subset of this number.

(c) refers to DEXA manufacturer (see below).

(d) stage 2 participation rate.

Source: Unpublished data and description of the study methodology provided to the AIHW by study groups.

To enable comparisons, measurements of BMD at the femoral neck (a section near the top of the thigh bone) were compared between the studies (Table 3.2).

Overall, the broad patterns across age and sex are similar in the epidemiological studies in Table 3.2 and the self-reported data presented in Chapter 2, Table 2.1. The prevalence of osteoporosis was higher in women than in men in each age group. In both men and women, the proportion of people with the condition increased with each additional decade of life.

However, there was a high level of variation in the age-group-specific estimates of osteoporosis prevalence from the different epidemiological studies, with wide confidence intervals for age-group-specific estimates in many cases, due to the relatively small sample sizes of the studies. It is therefore challenging to compare these estimates directly with each other and with self-reported estimates.

For men aged 60 and over, and women aged 80 and over, the measured prevalence estimates from the epidemiological studies are higher than the estimates from the national self-reported survey (Table 2.1). This is an expected result because the epidemiological studies include undiagnosed cases. It is not possible to describe the extent of under-diagnosis in these age groups with certainty, due to the wide range of prevalence estimates from the epidemiological studies.

Below the age of 60 for men, and 80 for women, the measured prevalence estimates from the epidemiological studies are sometimes lower than the estimates based on self-reports. This result may be due to the inclusion of osteopenia and osteoporosis in the self-reported rate, where the measured rate only includes osteoporosis. The uncertainty of the estimates (as indicated by relatively large confidence intervals), particularly of the measured rates, may also have contributed to this result.

**Table 3.2: Proportion of study participants aged 50 and over with osteoporosis based on measured BMD at the femoral neck, by age and sex**

	Dubbo Osteoporosis Epidemiological Study (n=2,045)	Geelong Osteoporosis Study (n= 1,668)	Tasmanian Older Adult Cohort Study (n=1,091)	North West Adelaide Health Survey (n=437)	Concord Health and Ageing in Men Project (n=1,662)
<b>Men</b>	<b>% (95% Confidence Interval)</b>				
50–59	..	0.4 (0.0–2.5)	1.9 (0.0–3.7)	1.3 (0.0–3.8)	..
60–69	7.9 (5.5–11.0)	2.9 (1.1–6.2)	3.4 (0.9–5.9)	5.9 (0.0–12.4)	..
70–79	15.4 (11.3–20.5)	9.2 (5.8–13.7)	4.2 (0.5–7.9)	19.5 (7.4–31.6)	7.0 (5.5–8.5)
80+	25.9 (16.1–39.6)	15.2 (11.0–19.4)	..	30.0 (9.9–50.1)	15.2 (12.0–18.4)
<b>Year of study</b>	<b>1990–1993</b>	<b>2001–2006</b>	<b>2002–2004</b>	<b>2004–2006</b>	<b>2006</b>
<b>Women</b>					
50–59	..	3.4 (1.4–6.8)	1.9 (0.2–3.6)	3.3 (0.0–7.0)	..
60–69	14.2 (11.4–17.5)	11.3 (7.3–16.4)	4.7 (1.7–7.8)	4.1 (0.0–8.6)	..
70–79	33.9 (28.6–39.8)	24.3 (18.6–30.7)	20.0 (12.2–28.8)	18.2 (8.0–28.2)	..
80+	52.5 (41.9–64.9)	41.5 (34.8–48.2)	..	32.1 (14.8–49.4)	..
<b>Year of study</b>	<b>1990–1993</b>	<b>1993–1997</b>	<b>2002–2004</b>	<b>2004–2006</b>	<b>..</b>

.. not applicable

Source: AIHW analysis of unpublished data provided to the AIHW by study groups.

In addition to the sample size issues described above, there are several other factors that make it difficult to compare estimates across epidemiological studies. While there is a general consensus on the definition of osteoporosis described in Box 1.1, the definition of osteoporosis using a cut-off of 2.5 standard deviations below the average (mean) bone density of young adults may produce a wide range of prevalence estimates due to the following factors.

- **Selected reference population:** The choice of reference population used to calculate the osteoporosis threshold is problematic. The original guidelines described the diagnosis of osteoporosis in older Caucasian women and there is still debate on the best reference population to use with other social groups, including men. Another contentious issue is the use of an international or a locally developed reference population to identify the thresholds for osteoporosis and osteopenia. While the Geelong Osteoporosis Study has collected data in order to establish an Australian reference range of peak bone mass for women (Henry et al. 2004) and, more recently, to men (Henry et al. 2010), these reference populations have not been consistently adopted in clinical practice or across these Australian studies.
- **DEXA manufacturer:** Although densitometers all measure BMD using dual-energy X-rays, variations exist in the bone density measurements between DEXA equipment made by different manufacturers. Conversion factors are required in order to make comparisons of BMD results between DEXA equipment made by different manufacturers (Ganda et al. 2014).
- **Reference period:** The selected epidemiological studies have been conducted over a number of years, with the earliest beginning over two decades ago. The prevalence estimates for osteoporosis are based on the BMD of study participants at point of entry into the study (that is, they are not updated over time). This makes comparing prevalence estimates generated from the studies difficult as there has been increased awareness around the prevention of the condition, and national prevalence may have decreased over time. This trend has been documented in the US, where the prevalence of osteoporosis, using a similar definition, appears to have decreased between 1988–1994 and 2005–2006 in those aged 50 and over (Looker et al. 2010).
- **Geographic representation:** While the studies may be considered representative of the area from which the sample was drawn, there is no epidemiological study with a nationally representative sample. Furthermore, the demographic variability between study regions may affect the comparability of the studies.
- **Bone mineral density measurement site:** A number of studies use BMD measurements at the hip or lumbar region of the spine; however, there is little agreement between these (and other) sites. A person with a T-score below 2.5 at the hip may have a T-score above this range when measured at the spine. In this report a single anatomical site, the femoral neck, was chosen to increase the comparability between studies, but the results here may produce different estimates from studies using multiple sites. The CHAMP study collected data from 3 sites (femoral neck, total hip and lumbar spine). For men aged 70–79, the combined prevalence of osteoporosis at any of these sites would have been 12% (compared with the 7% reported here), and 19% in men 80 and over (compared with 15% reported here).

## 4 The impact of osteoporosis

A major feature of osteoporosis is fractures that occur following little or no trauma, known as minimal trauma fractures. These fractures can result in pain and impaired functioning, leading to a decrease in the ability to undertake day-to-day tasks and to a loss of independence.

However, a substantial proportion of all minimal trauma fractures occur in people who do not have osteoporosis. This is because a range of factors other than osteoporosis contribute to minimal trauma fracture risk, such as high bone turnover, low body weight, a tendency to fall or previous history of falls, and a history of minimal trauma fractures (Nguyen et al. 2007, Arden 2006).

Fractures generate substantial costs to the community, with large direct health costs in terms of hospital treatment. For example, hospital procedures for partial hip replacements following a minimal-trauma hip fracture cost in the range of \$15,500 to \$19,500 (AIHW 2010). The broader costs of fracture can also be extensive and include lost productivity, carer costs, temporary residential aged care facility placement, if required, and costs associated with the provision of assistance with activities of daily living during the recovery period. For those whose fractures result in long-term functional limitations or disability, there may be considerable costs relating to permanent residential aged care facility placement or help to live independently.

This section presents a summary of key information about minimal trauma fracture in Australia, to shed light on the impact of osteoporosis on the Australian population. Estimates of the lifetime risk of minimal trauma fracture in Australia are presented. However, in the absence of complete data about the occurrence of minimal trauma fracture in Australia, information is then presented about hospitalisation for minimal trauma hip fracture.

### Lifetime risk of minimal trauma fracture

Some of the studies described in the previous chapter followed a cohort of participants to measure the occurrence of fractures over a long period. These studies included information about all diagnosed fractures, including those managed in primary care, outpatient care and through hospitalisation. Such detailed fracture information is not available for the general population.

Using such cohort information, we know that the lifetime risk of fracture is substantial. For example, the Tasmanian Older Adult Cohort Study estimated the residual lifetime risk of an osteoporotic fracture in men and women aged over 50 to be 27% and 44% respectively (that is, 1 in 4 men and 2 in 5 women in this age group would experience some form of osteoporotic fracture) (Cooley & Jones 2001). The Geelong Osteoporosis Study estimated the lifetime fracture risk in women aged 50 and over to be 42% (Doherty et al. 2001) and the Dubbo Osteoporosis Epidemiological Study estimated the residual lifetime risk in those aged 60 and over to be 29% in men and 56% in women (Jones et al. 1994).

## Minimal trauma hip fracture

Hip fracture (that is, a break occurring at the top of the thigh bone) is the only type of minimal trauma fracture likely to be comprehensively captured in the National Hospital Morbidity Database (NHMD), as it necessarily involves hospitalisation and surgery. Hip fracture is the most serious minimal trauma fracture, and is associated with the most complications (Johnell & Kanis, 2005). These fractures are a considerable burden on the community and the Australian health system.

The NHMD is a comprehensive dataset that has records for all episodes of admitted patient care ('hospital separations') from essentially all hospitals in Australia (Box 4.1). Cases where the patient was transferred between hospitals were excluded from this analysis to avoid double counting and to provide a more accurate estimate of the number of minimal trauma hip fractures (Appendix A).

### **Box 4.1: Hospitalisations, principal diagnoses and external cause codes**

A 'hospital separation' is the term used to refer to an episode of admitted patient care, which can be a total hospital stay (from admission to discharge, transfer or death) or a portion of a hospital stay beginning or ending in a change of type of care (AIHW 2013a). In this report, the term 'hospitalisation' and 'hospital separation' are used interchangeably.

For each hospitalisation, patients are assigned a 'principal diagnosis', which is the diagnosis established, after study, to be chiefly responsible for occasioning the patient's episode of admitted patient care.

Whenever a patient has a principal or additional diagnosis of an injury, poisoning or adverse event (such as a fracture), an 'external cause' code may be recorded. An external cause is defined as the environmental event, circumstance or condition that caused the injury, poisoning or adverse event (AIHW 2012).

In 2011–12 an estimated 19,000 people over the age of 50 were hospitalised due to a minimal trauma hip fracture (Table 4.1). Seventy-one per cent occurred in those aged 80 and over and 72% were in women.

These hip fractures occurred at a rate of 263 per 100,000 population. After adjusting for differences in the age structure, women (362 per 100,000) were over 2.5 times as likely as men (139 per 100,000) to be hospitalised with a hip fracture. Age-specific rates of minimal trauma hip fractures were highest in those aged 80 and older, at 1,573 per 100,000 population, compared with 17 per 100,000 for people aged 50–59.

**Table 4.1: Hospitalisations per 100,000 population for minimal trauma hip fractures, people aged 50 and over, 2011–12**

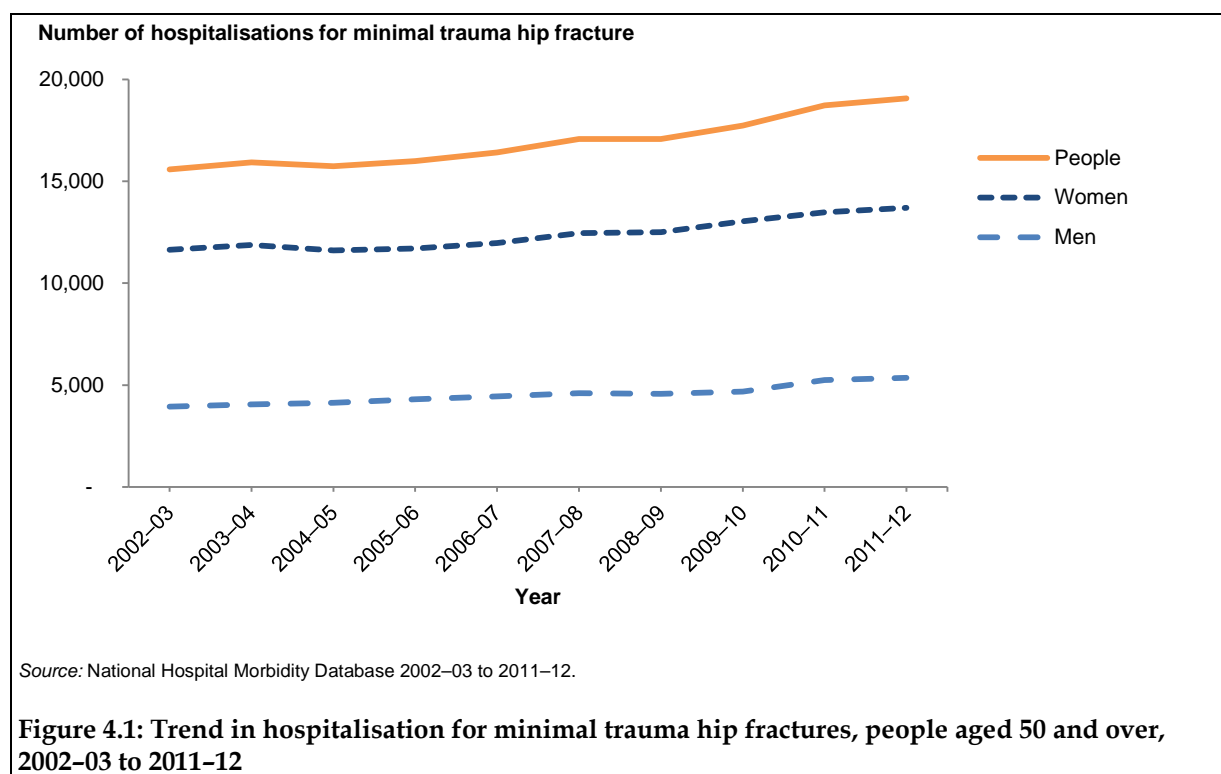
Age	Men		Women		People	
	Count	Rate <sup>(a)</sup>	Count	Rate <sup>(a)</sup>	Count	Rate <sup>(a)</sup>
50–59	183	13	304	21	487	17
60–69	535	49	889	80	1,424	64
70–79	1,193	190	2,476	364	3,669	281
80+	3,450	1,030	10,033	1,922	13,483	1,573
<b>Total aged 50 and over</b>	<b>5,361</b>	<b>154</b>	<b>13,702</b>	<b>365</b>	<b>19,063</b>	<b>263</b>
<b>Age-standardised rate<sup>(b)</sup></b>		<b>168</b>		<b>312</b>		<b>251</b>

(a) per 100,000 population.

(b) age-standardised to the Australian population as at 30 June 2001.

Source: National Hospital Morbidity Database 2011–12.

Between 2002–03 and 2011–12, the number of hospitalisations for minimal trauma hip fracture among people aged 50 and over increased by 22% (from 15,588 in 2002–03 to 19,063 in 2011–12). The number increased by 36% for men, and 18% for women (Figure 4.1; Appendix B). Over the same period, the age-standardised rate of hospitalisations for minimal trauma hip fracture for people aged 50 and over decreased slightly, from 270 per 100,000 in 2002–03 to 251 per 100,000 in 2011–12.



## 5 Discussion

This report has provided a brief overview of what is known about the prevalence and impact of osteoporosis in Australia by presenting various sources of information relating to the prevalence of osteoporosis in Australia and the incidence of minimal trauma hip fracture.

### Prevalence of osteoporosis

Osteoporosis is a significant health concern for older Australians. One of the larger and more recent studies of measured BMD (the Geelong Osteoporosis Study) estimates it affects 6% of men and 23% of women over the age of 50 (Henry et al 2011). This estimate is higher than the self-reported estimate of diagnosed cases from the AHS (3% of men and 15% of women), as would be expected for a condition that may not be diagnosed due to an absence of overt symptoms.

Due to the variation in age-group-specific estimates of osteoporosis prevalence between the epidemiological studies that measured osteoporosis, it was not sensible to directly compare the national self-reported survey with the epidemiological studies to draw conclusions about the extent of under-diagnosis of osteoporosis in Australia by age group.

Despite the observed variation between data sources, the broad patterns of prevalence across the age groups were relatively consistent. All of the datasets confirm that the proportion of people with the condition increased with each additional decade of life and the prevalence of osteoporosis is higher in women than in men.

The report acknowledges the lack of comprehensive data relating to the impact of osteoporosis among residents of aged care facilities. Limited data from the ACFI demonstrate that for 12% of permanent aged care residents, osteoporosis is one of the three most significant health problems impacting on the residents' care needs. The effective care and prevention of falls and fractures in these settings is a crucial strategy among these high-fracture-risk residents. This is particularly relevant given Australia's ageing population and the increasing need for aged care services.

### Impact of osteoporosis

The impact of osteoporosis includes a range of costs, including the personal and health system costs of managing the condition and the potentially extensive costs related to associated fractures. Costs may include lost productivity, carer costs, and costs associated with temporary or permanent residential aged care facility placement or home support.

While not all minimal trauma fractures occur in people with osteoporosis, fracture risk is higher for those with the condition and fracture statistics therefore provide insight into the impact of osteoporosis and the benefits of its prevention. Fractures generate substantial costs to the community (AIHW 2010; Watts et al. 2013).

At age 50 to 60, the future lifetime risk of sustaining a minimal trauma fracture is estimated to be 27 to 29% in men and 42 to 56% in women (Cooley & Jones, 2001; Doherty et al, 2001; Jones et al. 1994). All major types of fracture are associated with an increased risk of premature death (Bliuc et al. 2013).



Minimal trauma fracture of the hip is one of the most serious outcomes of osteoporosis. According to the NHMD, in 2011–12 the rate of minimal trauma hip fracture for people aged 50 and over was 365 per 100,000 women, and 154 per 100,000 men.

Analysis showed that, although the age-standardised rate has decreased slightly, the number of hospitalisations for minimal trauma hip fracture has risen over the past ten years.

Previous research has found that the decrease in the age-standardised rate of hip fracture is statistically significant (Crisp et al. 2012). To date there is no robust data to indicate if fracture rates at other sites have changed in the past ten years.

## Conclusion

This report demonstrates that no single source of information can provide a definitive prevalence estimate of osteoporosis in Australia. Given its 'silent' nature, it is often assumed that the condition is under-diagnosed. The higher prevalence estimate from the Geelong Osteoporosis Study, where bone density was measured, in comparison with diagnosed prevalence from the AHS, lends support to the idea that osteoporosis is underdiagnosed in Australia. However, a detailed comparison of epidemiological studies with the AHS did not shed light on the extent of this under-diagnosis by age or by sex group.

This report highlights that, although national health surveys provide valuable information on self-reported levels of diagnosed osteoporosis in the community, additional sources of information, such as administrative datasets and epidemiological studies, supplement this information and provide additional valuable information about the prevalence and impact of this condition.

# Appendix A: Data sources

## AIHW National Hospital Morbidity Database

The National Hospital Morbidity Database (NHMD) is a comprehensive dataset that has records for all episodes of admitted patient care from essentially all hospitals in Australia.

For the purpose of this report, a 'separation for minimal trauma fracture' was defined as any separation of a person aged 50 or over with a principal diagnosis of a fracture and an external cause code indicating minor trauma.

Separations where the patient was transferred from another hospital were excluded, as this provides a more accurate estimate of the number of fractures that required hospital treatment.

**Table A.2: ICD-10-AM codes used in identifying fractures in NHMD**

Fracture region and site <sup>(a)</sup> and external cause	ICD-10-AM codes
Hip	
Femoral neck	S72.0
Petrochanteric	S72.1
Subtrochanteric	S72.2
External cause	
Minimal trauma falls	W00, W01, W03–W08, W18, W19
Other minimal trauma events	W22, W50, W51, W54.8

(a) Based on principal diagnosis.

## Aged Care Funding Instrument

The Aged Care Funding Instrument (ACFI) is used to determine Australian government subsidies for permanent aged care residents. It is primarily focused on collecting information that is relevant to the costs of care for individual residents.

ACFI appraisals are not conducted on a regular basis and have a focus on components of the resident's care needs that affect the cost of care. Consequently, inclusion of medical diagnoses may be affected by their relevance to care needs and the number of available diagnosis fields.

Health conditions listed in the ACFI are coded using the Aged Care Assessment Program code list. This code list is based on the ICD-10-AM classification and is comparable to the ABS 4-digit code used for the ABS Survey of Disability, Ageing and Carers.

## Australian Health Survey

The Australian Health Survey (AHS) 2011–12 comprised two components: the National Health Survey (NHS) and the National Nutrition and Physical Activity Survey (NNPAS).

For the purposes of this report, when discussing the findings of the NHS, respondents were classified as having osteoporosis if they had ever been told by a doctor or nurse that they had osteoporosis or osteopenia.

The 2011–12 NHS collected information by face-to-face interview from usual residents of private dwellings in urban and rural areas of Australia, covering about 97% of the people living in Australia. People in scope for the survey were those identified by an adult within each sampled private dwelling as a usual resident of that dwelling. Private dwellings are houses, flats, home units, caravans, garages, tents and other structures being used as a place of residence at the time of the survey.

Based on information collected from a sample of randomly chosen Australians, these surveys provide nationally representative estimates for the Australian population.

## Appendix B: Additional table

Table B.1: Number of hospitalisations for minimal trauma hip fracture, people aged 50 and over, 2002-03 to 2011-12

Year	Number of hospitalisations for minimal trauma hip fracture		
	Men	Women	People
2002-03	3,944	11,644	15,588
2003-04	4,057	11,874	15,931
2004-05	4,134	11,607	15,741
2005-06	4,301	11,698	15,999
2006-07	4,443	11,969	16,412
2007-08	4,605	12,464	17,069
2008-09	4,576	12,499	17,075
2009-10	4,685	13,045	17,730
2010-11	5,253	13,474	18,727
2011-12	5,361	13,702	19,063

Source: AIHW National Hospital Morbidity Database 2002-03 to 2011-12.

# References

- ABS (Australian Bureau of Statistics) 2012. Australian Health Survey: first results, 2011–12. ABS cat. no. 4364.0.55.001. Canberra: ABS.
- AIHW (Australian Institute of Health and Welfare) 2008. Arthritis and osteoporosis in Australia 2008. Arthritis series no. 8. Cat. no. PHE 106. Canberra: AIHW.
- AIHW 2010. The problem of osteoporotic hip fracture in Australia. AIHW bulletin no. 76. Cat. no. AUS 121. Canberra: AIHW.
- AIHW 2011. Use of antiresorptive agents for osteoporosis management. Cat. no. PHE 148. Canberra: AIHW.
- AIHW 2012. National Health Data Dictionary 2012 version 16. Cat. no. HWI 119. Canberra: AIHW.
- AIHW 2013a. Australian hospital statistics 2011–12. Health services series 50. Cat. no. HSE 134. Canberra: AIHW.
- AIHW 2013b. Depression in residential aged care 2008–2012. Aged care statistics series no. 39. Cat. no. AGE 73. Canberra: AIHW.
- AIHW 2014. Health-care expenditure on arthritis and other musculoskeletal conditions 2008–09. Canberra: AIHW.
- Arden N 2006. Osteoporosis. 2nd edn. London: Remedica.
- Bliuc D, Nguyen ND, Nguyen TV, Eisman JA & Center JR 2013. Compound risk of high mortality following osteoporotic fracture and refracture in elderly women and men. *Journal of Bone and Mineral Research* 28(11):2317–24.
- Cooley H & Jones G 2001. A population-based study of fracture incidence in southern Tasmania: lifetime fracture risk and evidence for geographic variations within the same country. *Osteoporosis International* 12(2):124–130.
- Crisp A, Dixon T, Jones G, Cumming RG, Laslett LL, Bhatia K et al. 2012. Declining incidence of osteoporotic hip fracture in Australia. *Archives of Osteoporosis* 7(1–2):179–185.
- Department of Health 2014. Browse the PBS. Canberra: Department of Health. Viewed 5 August 2014, <<http://www.pbs.gov.au/browse/body-system>>
- Doherty DA, Sanders KM, Kotowicz MA & Prince RL 2001. Lifetime and five-year age-specific risks of first and subsequent osteoporosis fractures in postmenopausal women. *Osteoporosis International* 12(1):16–23.
- Ebeling PR, Daly RM, Kerr DA & Kimlin MG 2013. Building healthy bones throughout life: an evidence-informed strategy to prevent osteoporosis in Australia. *Medical Journal of Australia Open* 2 (Supplement 1):1–46.
- Edwards MH, Jameson K, Denison H, Harvey NC, Sayer AA, Dennison EM et al. 2013. Clinical risk factors, bone density and fall history in the prediction of incident fracture among men and women. *Bone* 52(2): 541–47.
- Ganda K, Nguyen TV & Pocock N 2014. Gender disparity in BMD conversion: a comparison between Lunar and Hologic densitometers. *Archives of Osteoporosis* 9(1):180.

- Henry MJ, Pasco JA, Pocock NA, Nicholson GC & Kotowicz MA 2004. Reference ranges for bone densitometers adopted Australia-wide: Geelong osteoporosis study. *Australasian Radiology* 48:473-5.
- Henry MJ, Pasco JA, Korn S, Gibson JE, Kotowicz MA & Nicholson GC. 2010. Bone mineral density reference ranges for Australian men: Geelong Osteoporosis Study. *Osteoporosis International* 21(6):909-17.
- Henry MJ, Pasco JA, Nicholson GC & Kotowicz MA. 2011. Prevalence of osteoporosis in Australian men and women: Geelong Osteoporosis Study. *Medical Journal of Australia* 195(6):321-322.
- Johnell O & Kanis J. 2005. Epidemiology of osteoporotic fractures. *Osteoporosis International* 16 (Supplement 2):S3-7.
- Jones G, Nguyen T, Sambrook PN, Kelly PJ, Gilbert C & Eisman JA. 1994. Symptomatic fracture incidence in elderly men and women: The Dubbo Osteoporosis Epidemiology Study (DOES). *Osteoporosis International* 4(5):277-282.
- Kanis JA & the WHO (World Health Organisation) Study Group. 1994. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis: synopsis of a WHO report. *Osteoporosis International* 4(6):368-381.
- Looker AC, Melton JL 3rd, Harris TB, Borrud LG & Shepherd JA 2010. Prevalence and trends in low femur bone density among older US adults: NHANES 2005-2006 compared with NHANES III. *Journal of Bone and Mineral Research* 25(1):64-71.
- Nguyen ND, Eisman JA, Center JR & Nguyen TV 2007. Risk factors for fracture in nonosteoporotic men and women. *The Journal of Clinical Endocrinology and Metabolism* 92(3):955-62.
- Watts JJ, Abimanyi-Ochom J, Sanders KM 2013. Osteoporosis costing all Australians: A new burden of disease analysis 2012 to 2022. Sydney: Osteoporosis Australia.



This report presents information about the prevalence and impact of osteoporosis in Australians aged 50 and over. A broad range of data sources show that osteoporosis prevalence markedly increases with age and is more common in women than in men. Osteoporosis is one of several risk factors for minimal trauma fracture, with minimal trauma fracture of the hip being one of the most serious possible outcomes of osteoporosis. Although the rate of minimal trauma hip fracture for people aged 50 and over has decreased over the last ten years, the number of hip fractures continues to increase due to the increasing number of older adults in Australia.