



Musculoskeletal conditions as underlying and associated causes of death

2013

Summary

Musculoskeletal conditions are a range of conditions that affect the bones, muscles and connective tissues. In this bulletin, the musculoskeletal conditions reported include osteoarthritis; rheumatoid arthritis; osteoporosis; back problems; gout and other inflammatory arthropathies (inflammation of one or more joints); and lupus and other systemic connective tissue disorders.

Arthritis and musculoskeletal conditions are not commonly recorded as the underlying cause of death; however, they are prevalent chronic diseases affecting 30% of Australians, and are more commonly reported as other causes that contributed to the death.



1 in 20 deaths in 2013 were directly caused by, or contributed to by, musculoskeletal conditions (6,963 deaths).



Of any musculoskeletal condition, osteoporosis made the greatest contribution to mortality, contributing to 1,856 deaths—as an underlying cause for 167 deaths and as the associated cause for 1,689 deaths (making it the most common musculoskeletal condition recorded as an associated cause).

81

81 was the average age at death for which musculoskeletal conditions were recorded as the underlying cause, compared with 76 years for deaths due to all causes.



2 in 3 deaths with a musculoskeletal condition recorded as an underlying cause in 2013 were among females (806 deaths compared with 375 deaths among males).

For the almost 148,000 deaths in 2013:

- ✦ musculoskeletal conditions were recorded as the underlying cause for 1,181 deaths (0.8% of all deaths) and as an associated cause for 5,782 deaths (3.9% of all deaths)
- ✦ the most common musculoskeletal condition group recorded as an underlying cause of death was lupus and other connective tissue disorders (245 deaths).

In 2011–2013, in cases where a musculoskeletal condition was recorded as an associated cause of death, the most common leading underlying cause of death was *Coronary heart disease*, followed by *Dementia and Alzheimer disease*, *Cerebrovascular disease*, *Chronic obstructive pulmonary disease* and *Diabetes*. This pattern was similar to the overall leading causes of death, which were *Coronary heart disease*, *Cerebrovascular disease*, *Dementia and Alzheimer disease*, *Lung cancer* and *Chronic obstructive pulmonary disease*.

The number of deaths where a musculoskeletal condition was recorded as either an underlying or an associated cause of death increased over time between 1997 and 2013, but this was consistent with changes in the age profile of the population.

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Introduction

Musculoskeletal conditions—conditions that affect the bones, muscles and connective tissues—are the most common chronic conditions in Australia. The most prevalent musculoskeletal conditions include osteoarthritis, rheumatoid arthritis, osteoporosis and back problems. In 2014–15, 30% of Australians (6.8 million people) reported having a musculoskeletal condition (ABS 2015b). Of these, 3.7 million were affected by back problems, 2 million by osteoarthritis, 802,000 by osteoporosis and 406,000 by rheumatoid arthritis.

Musculoskeletal conditions pose a substantial burden on the community, both economic and personal, through the need for hospital and primary health-care services, disruption to daily life and lost productivity (AIHW 2005; AIHW 2014). Most of these conditions cause ongoing pain and disability—but not death—and are measured as a high non-fatal burden of disease (Murray et al. 2012; Vos et al. 2012) and a low burden of mortality (AIHW 2015b).

Musculoskeletal conditions can contribute to deaths when they occur as a comorbid condition associated with the underlying cause of death. Comorbidities can complicate treatment and management of diseases, leading to more serious health impacts and reduced quality of life. Studies have shown that the mortality rate for all causes is raised following hospitalisation for musculoskeletal conditions, particularly for osteoporosis (Zeltzer et al. 2014) and osteoarthritis (Barbour et al. 2015).

This bulletin explores the possible contribution of musculoskeletal conditions to mortality in Australia, by presenting the latest data from the AIHW National Mortality Database on musculoskeletal conditions reported as both underlying and associated causes of death.

Cause of death information is sourced from death certificates. The quality and completeness of this information is therefore dependent on what is entered by the person certifying the death. Cause of death data is classified according to the *International Classification of Diseases and Related Health Problems* (ICD); for the purposes of this bulletin, causes of death are classified according to the 10th revision (ICD-10). For details see Appendix A.

The process of coding deaths on death certificates and the terminology to describe the different cause types used in this bulletin is presented in Box 1.

Box 1: Describing causes of death

In Australia, the format of the death certificate enables a medical practitioner to document all medical conditions instrumental in causing the death, including the condition that led directly to death (the immediate cause), all the antecedent causes (that is, those that occurred as a result of the reported underlying cause and before the immediate cause) and all other significant conditions that contributed to the death but were not related to the disease or condition that caused it. Collectively, these conditions are referred to as ‘associated causes of death’ in this report.

The information documented on death certificates is coded by the Australian Bureau of Statistics (ABS) to the international standard recommended by the World Health Organization. The coding process considers the sequence of occurrence of each disease or health condition, removes duplicate disease information and applies other logical rules to select the underlying cause. This process is largely automated and results in a standardised output that can be used for statistical analyses of causes of death, at both a national and international level.

(continued)

Box 1 (continued): Describing causes of death

Key definitions used to describe causes of death:

- **underlying cause of death** is the condition, disease or injury that initiated the train of events leading directly to death.
- **associated causes of death** refer to causes—other than the underlying cause of death—listed on the death certificate that were instrumental in causing death and encompasses conditions that intervened or significantly contributed to the death.
- **multiple causes of death** are defined as all causes listed on the death certificate. This includes the underlying cause of death and all associated causes of death.

In this bulletin a death is described as being *due to* an underlying cause of death, or *contributed to* by an associated cause of death. For details on completing a cause of death certificate in Australia, see ABS 2008.

Source: ABS 2015a.

Musculoskeletal conditions and mortality

Arthritis and musculoskeletal conditions are not commonly recorded as the 'underlying' cause of death (the disease or injury that initiated the train of events leading directly to death). In 2013, musculoskeletal conditions were recorded as the 'underlying' cause in 1,181 deaths (0.8% of all deaths) and recorded as an 'associated' cause in 5,782 deaths (3.9% of all deaths). Therefore, it is likely that musculoskeletal conditions contributed to about 1 in 20 deaths in 2013 (ABS 2015a).

Examples of ways in which the specific musculoskeletal conditions reported in this bulletin could have contributed to death as underlying or associated causes are outlined.

Back problems

Back problems are a range of conditions related to the bones, joints, connective tissue, muscles and nerves of the back. In an Australian population of 70 to 85 year olds, daily back pain was found to be associated with greater overall mortality risk and increased risk of coronary heart events (Zhu et al. 2007). Severe chronic pain, like that experienced due to back problems, has also been demonstrated to be a risk factor for suicidal thoughts and behaviours (Tang & Crane 2006).

Gout and other inflammatory arthropathies

Gout is a form of arthritis which causes severe pain and swelling of the joints. Unlike other forms of arthritis, gout is more likely to affect men and symptoms begin suddenly and affect a person periodically. The pain, swelling and inflammation are caused by a build-up of urate crystals in the joint which occurs when the body produces too much uric acid or excretes too little in the urine.

A systematic review and meta-analysis found gout to be associated with an increased risk of cardiovascular disease mortality (Clarson et al. 2015).

Lupus and other systemic connective tissue disorders

Lupus and other systemic connective tissue disorders are autoimmune conditions (conditions where the body's immune system mistakenly attacks healthy cells and tissues). They are characterised by chronic inflammation and degeneration of connective tissue throughout the body, including muscles, joints, skin and blood vessels. Lupus may be mild or life-threatening, depending on which parts of the body are affected (Garvan Institute of Medical Research 2016).

People with systemic autoimmune conditions are at increased risk of premature mortality from associated complications, such as kidney disease, irreversible organ damage, cardiovascular disease, infections and cancer, which can affect many people during the course of the disease (Yung & Chan 2015; Yee et al. 2015).

Osteoarthritis

Osteoarthritis is a degenerative joint condition affecting weight-bearing joints such as the hips, knees and ankles as well as the hands, feet and spine. In the initial stages, pain occurs in the joints during and after activity. As the condition progresses, pain may be experienced from minimal movement or during rest.

Osteoarthritis is known to be associated with an increased risk of cardiovascular disease mortality (Barbour et al. 2015; Kluzek et al. 2015).

Osteoporosis

Osteoporosis is a condition that causes decreased bone density, making bones more fragile and prone to breakage in response to minimal trauma events like tripping and falling. Osteoporosis prevalence increases with age as natural bone mineral density loss increases. When fractures occur in older people, these fractures can be more complicated to treat and bring a greater risk of mortality.

Hip fractures, in particular, are associated with increased mortality rates. This can be due to complications following surgery, such as blood clots, pulmonary embolism, infections and heart failure (Massó González et al. 2010; Panula et al. 2011). It has been suggested that hip fractures are associated with a five- to eight-fold increase in the risk of death within the first 3 months following the fracture (Haentjens et al. 2010) and the increased risk persists for up to 10 years (Bliuc et al. 2009). Australian research has suggested that older people are, on average, more likely to die following hip fracture surgery (BHI 2013).

When a fracture occurs as a result of a minimal trauma event, it is referred to as a 'minimal trauma fracture'. Minimal trauma fractures may be used as an indicator of osteoporosis (Osteoporosis Australia 2015), with a suspected half of these fractures being associated with osteoporosis (Schuit et al. 2004). Minimal trauma fractures are frequently undiagnosed (Vaile et al. 2007). In this bulletin, minimal trauma fractures are excluded from the analyses, which may mean there is an undercount of deaths due to musculoskeletal conditions.

Rheumatoid arthritis

Rheumatoid arthritis is an inflammatory, autoimmune disease where the immune system attacks the tissues in the joints causing pain, joint stiffness and loss of function. The disease can also lead to problems with the heart, respiratory system, nerves and eyes.

The systemic inflammation present in rheumatoid arthritis may contribute to the development of cardiovascular disease (Toledano et al. 2012; Lassere et al. 2013). Rheumatoid arthritis is also associated with increased mortality due to infections, respiratory diseases, and gastrointestinal disorders (Lassere et al. 2013; Myasoedova et al. 2010).

Results

Overall contribution of musculoskeletal conditions to mortality

In 2013, there were 147,678 deaths registered in Australia. Musculoskeletal conditions were reported as the underlying cause in 1,181 deaths (0.8% of all deaths) and as an associated cause in 5,782 deaths (3.9% of all deaths). Therefore, musculoskeletal conditions are likely to have contributed to about 1 in 20 deaths (6,963) in 2013 (Table 1).

Table 1: Musculoskeletal conditions as causes of death, 2013

Cause of death	Deaths	
	Number	%
Musculoskeletal conditions as underlying cause of death	1,181	0.8
Musculoskeletal conditions as associated cause of death ^(a)	5,782	3.9
<i>Total deaths related to musculoskeletal conditions</i>	<i>6,963</i>	<i>4.7</i>
Total deaths from all causes	147,678	100.0

(a) Excludes deaths where musculoskeletal conditions were listed as an underlying cause of death to avoid double-counting.

Source: AIHW National Mortality Database.

The musculoskeletal condition making the greatest contribution to mortality was osteoporosis with 1,856 deaths (167 as an underlying cause and 1,689 as an associated cause), followed by osteoarthritis with 1,696 deaths (138 as an underlying cause and 1,558 as an associated cause) and rheumatoid arthritis with 917 deaths (194 as an underlying cause and 723 as an associated cause).

Musculoskeletal conditions as underlying causes of death

The most common musculoskeletal condition listed as an underlying cause of death was lupus and other connective tissue disorders (245 deaths). Lupus and other systemic connective tissue disorders are not common musculoskeletal conditions, with prevalence estimates ranging from 19 to 53 per 100,000 people (Jakes et al. 2012). However, due to the severe nature of these conditions, they result in higher mortality (as an underlying cause of death) compared to other musculoskeletal conditions.

Rheumatoid arthritis was the second most common musculoskeletal condition recorded as an underlying cause of death (194 deaths), followed by osteoporosis (167 deaths), osteoarthritis (138 deaths), back problems (57 deaths), and gout and other inflammatory arthropathies (45 deaths) (Table 2).

Table 2: Top 6 musculoskeletal conditions reported as underlying causes of death, 2013

Underlying cause of death	Number	% ^(a)
Lupus and other connective tissue disorders	245	21
Rheumatoid arthritis	194	16
Osteoporosis	167	14
Osteoarthritis	138	12
Back problems	57	5
Gout and other inflammatory arthropathies	45	4
Other musculoskeletal conditions	335	28
Total musculoskeletal conditions	1,181	100

(a) Proportion of all deaths with a musculoskeletal condition as the underlying cause of death.

Source: AIHW National Mortality Database.

Deaths by age and sex

People who had a musculoskeletal condition recorded as the underlying cause of their death tended to have lived beyond 76, which is the average age of death from all causes (AIHW 2015c). In 2013, the average age at death for people with musculoskeletal conditions reported as the underlying cause of death was 81 years.

For people with osteoarthritis reported as the underlying cause of death, the average age at death was 91, closely followed by osteoporosis at 90; while for people with lupus and other connective tissue disorders as the underlying cause of death, the average age was 73 years (Table 3).

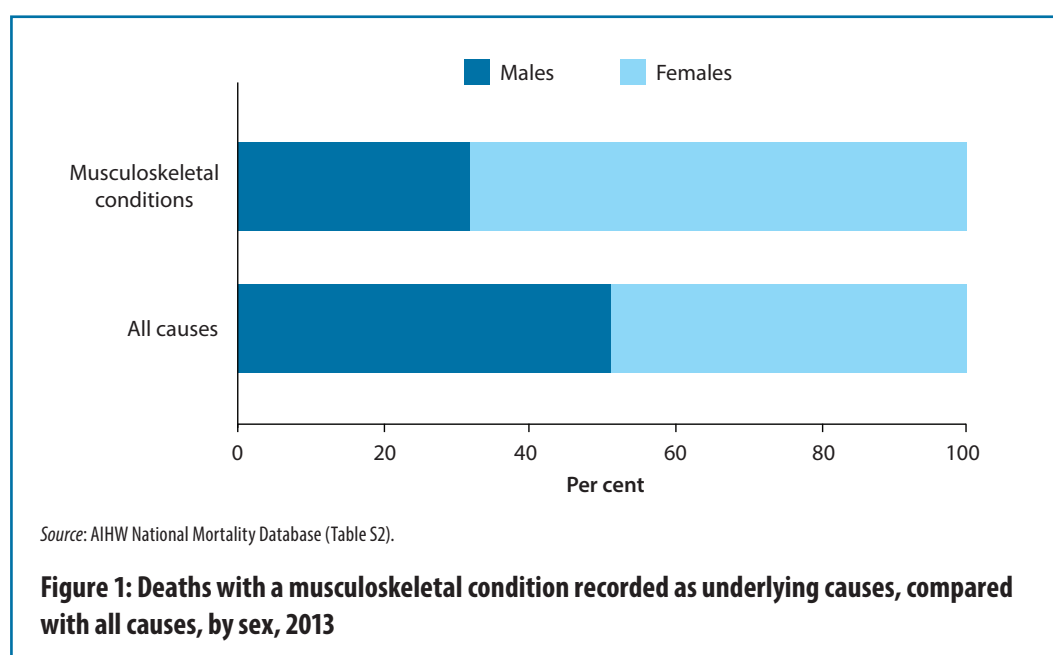
Table 3: Average age at death for musculoskeletal conditions reported as the underlying cause, 2013

Condition	Average age at death
Osteoarthritis	91
Osteoporosis	90
All musculoskeletal conditions	81
Back problems	80
Rheumatoid arthritis	80
Gout and other inflammatory arthropathies	79
Lupus and other connective tissue disorders	73

Source: AIHW National Mortality Database.

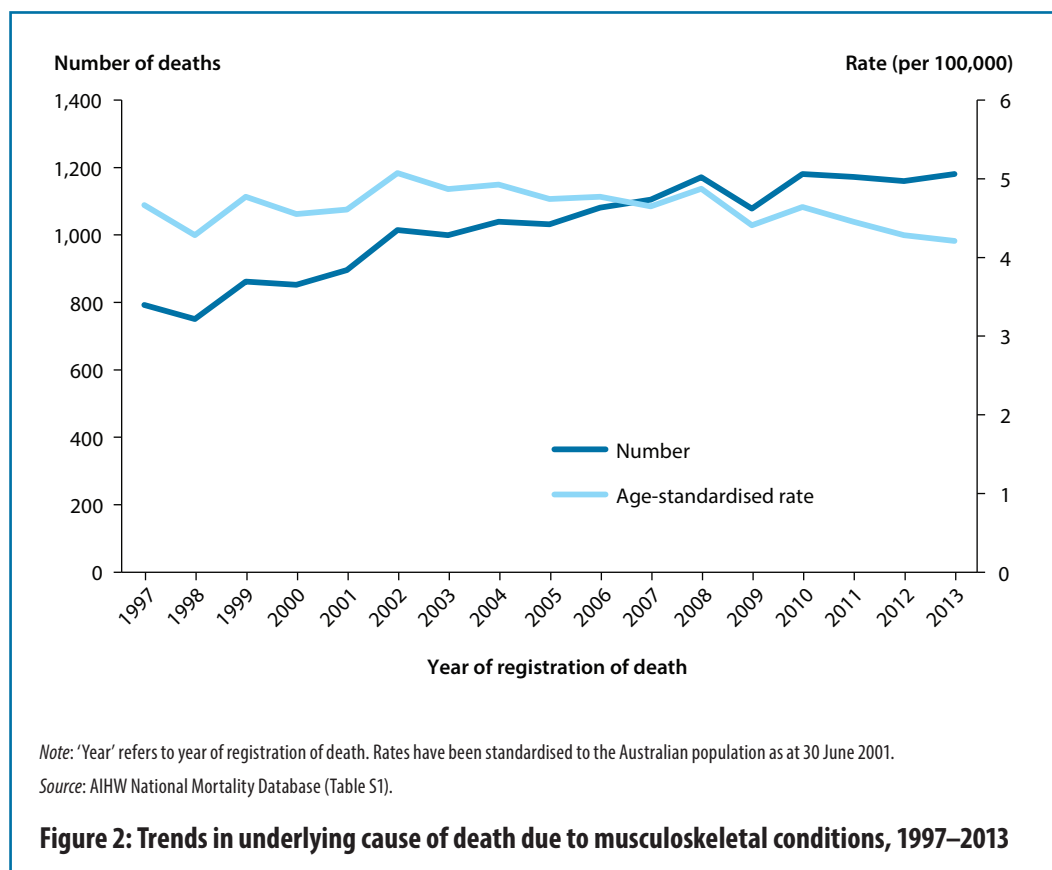
The number of deaths with a musculoskeletal condition as an underlying cause was greater for females compared with males (Figure 1): in 2013, about two-thirds (68%) of deaths with musculoskeletal conditions as an underlying cause were among females (806 deaths compared with 375 deaths among males). This reflects the prevalence of musculoskeletal conditions in Australia, which is generally higher in women than men, in particular for osteoarthritis, osteoporosis and rheumatoid arthritis (AIHW 2015a). In contrast, 51% of deaths from all causes were among males (75,782 deaths compared with 71,896 deaths among females) (AIHW 2015c).

The greater number of deaths due to musculoskeletal conditions among females has been consistent over time (Table S1). The higher proportion of deaths for females compared with males was also consistent across almost all age groups and remained true when the age distribution of the sexes was taken into account (Table S2).



Change over time

Since 1997, the total number of deaths due to musculoskeletal conditions has increased for both males and females. However, after adjusting for changes in the size and age structure of the population, there has been no significant change in the mortality rate per 100,000 population between 1997 and 2013 (Figure 2).



Musculoskeletal conditions as associated causes of death

The most common musculoskeletal condition listed as an associated cause of death was osteoporosis (1,689 deaths) followed by osteoarthritis (1,558 deaths), rheumatoid arthritis (723 deaths), back problems (512 deaths), gout and other inflammatory arthropathies (485 deaths) and lupus and other connective tissue disorders (450 deaths) (Table 4).

Table 4: Top 6 musculoskeletal conditions recorded as associated causes of death, 2013

Associated cause of death	Number	% ^(a)
Osteoporosis	1,689	29
Osteoarthritis	1,558	27
Rheumatoid arthritis	723	13
Back problems	512	9
Gout and other inflammatory arthropathies	485	8
Lupus and other connective tissue disorders	450	8
Other musculoskeletal conditions	1,252	22
Total deaths with musculoskeletal conditions listed as an associated cause^(b)	5,782	100

(a) Proportion of all musculoskeletal deaths listed as an associated cause of death.

(b) The total number of deaths where one or more musculoskeletal conditions were listed as an associated cause of death.

Note: Components will not sum to total, as one death can have more than one musculoskeletal condition as an associated cause of death.

Source: AIHW National Mortality Database.

Deaths by age and sex

The average age at death in 2013 for people with a musculoskeletal condition as an associated cause of death was 83 years. For people with osteoarthritis listed as an associated cause, the average age was 87 years, while for people with back problems listed as an associated cause, the average age was 78 years (Table 5).

Table 5: Average age at death for musculoskeletal conditions listed as associated causes, 2013

Condition	Average age at death
Osteoarthritis	87
Osteoporosis	86
All musculoskeletal conditions	83
Gout and other inflammatory arthropathies	82
Rheumatoid arthritis	80
Lupus and other connective tissue disorders	79
Back problems	78

Source: AIHW National Mortality Database.

In 2013, almost twice as many females died with musculoskeletal conditions as an associated cause compared with males (3,681 compared with 2,101 deaths) (Figure 3). The higher proportion of deaths among females was consistent across almost all age groups and remained true when the age distribution of the sexes was taken into account (Table S3).

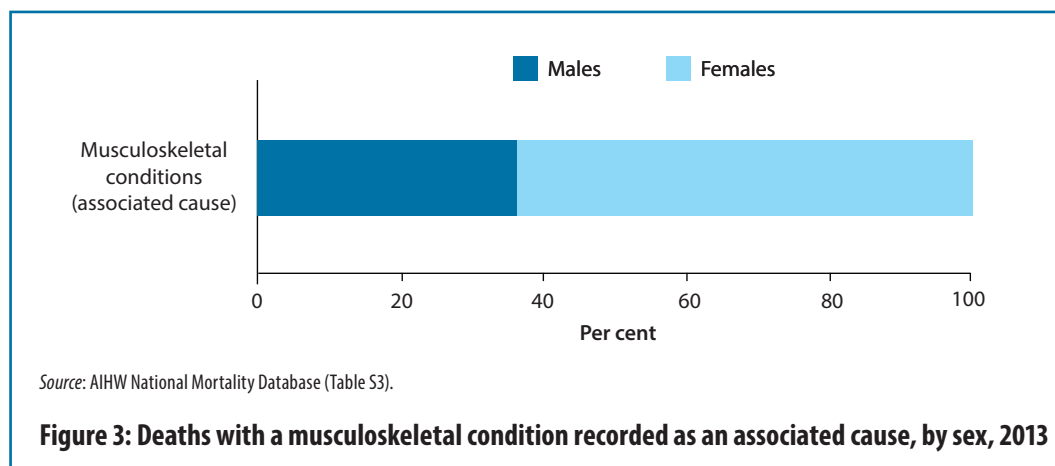


Figure 3: Deaths with a musculoskeletal condition recorded as an associated cause, by sex, 2013

Change over time

From 1997, the total number of deaths with a musculoskeletal condition listed as an associated cause increased for both males and females. After adjusting for changes in the size and age structure of the population, between 1997 and 2013 there was no significant change in the mortality rate per 100,000 population (Figure 4).

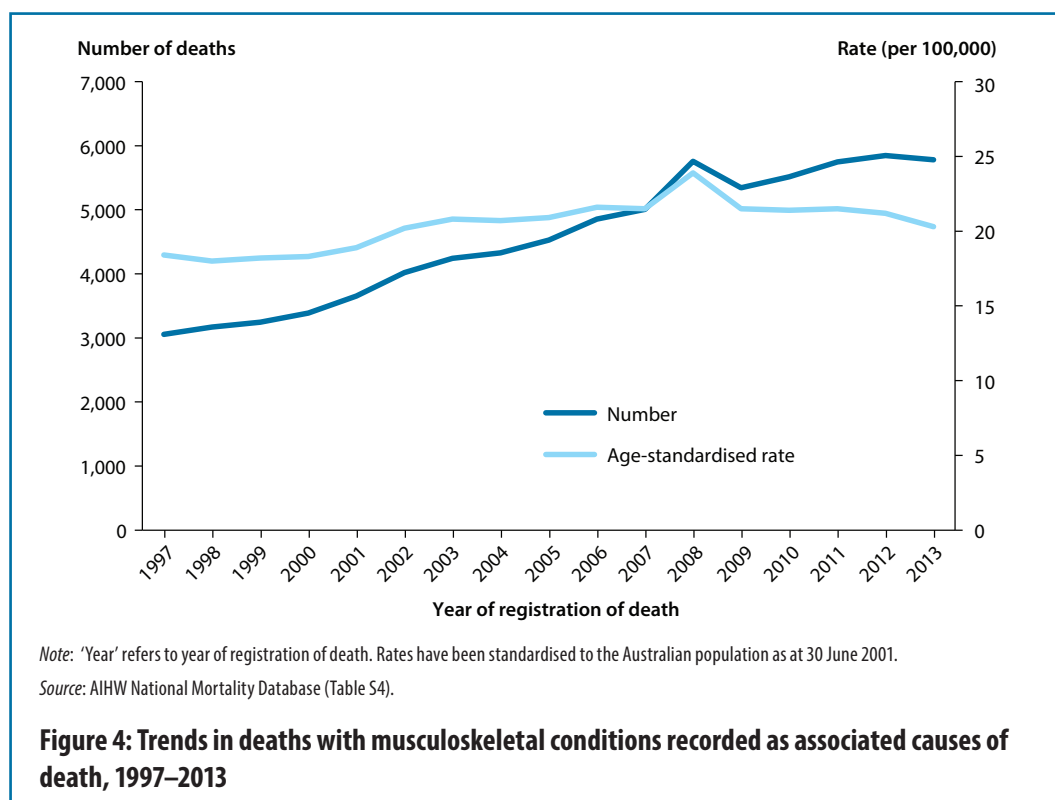


Figure 4: Trends in deaths with musculoskeletal conditions recorded as associated causes of death, 1997–2013

Leading causes of death where musculoskeletal conditions were an associated cause

Where a musculoskeletal condition was listed as an associated cause of death, the leading underlying cause of death was most commonly reported as *Coronary heart disease*. Where osteoporosis or osteoarthritis were reported as associated causes of death, *Dementia and Alzheimer disease* was the leading underlying cause of death, followed by *Coronary heart disease*. The most common underlying causes of death for each of the selected musculoskeletal conditions are listed in Table 6. For comparison, Table S5 includes the overall top 5 underlying causes of death for the Australian population.

Table 6: Most common underlying causes of death when musculoskeletal conditions were listed as associated causes of death, 2011–2013

Associated musculoskeletal cause of death	Leading underlying causes of death				
	1st	2nd	3rd	4th	5th
All musculoskeletal conditions ^(a)	Coronary heart disease (I20–I25)	Dementia and Alzheimer disease (F01, F03, G30)	Cerebrovascular disease (I60–I69)	Chronic obstructive pulmonary disease (J40–J44)	Diabetes (E10–E14)
Back problems	Coronary heart disease (I20–I25)	Dementia and Alzheimer disease (F01, F03, G30)	Chronic obstructive pulmonary disease (J40–J44)	Cerebrovascular disease (I60–I69)	Diabetes (E10–E14)
Gout and other inflammatory arthropathies	Coronary heart disease (I20–I25)	Dementia and Alzheimer disease (F01, F03, G30)	Cerebrovascular disease (I60–I69)	Diabetes (E10–E14)	Chronic obstructive pulmonary disease (J40–J44)
Osteoarthritis	Dementia and Alzheimer disease (F01, F03, G30)	Coronary heart disease (I20–I25)	Cerebrovascular disease (I60–I69)	Hypertensive disease (I10–I15)	Diabetes (E10–E14)
Osteoporosis	Dementia and Alzheimer disease (F01, F03, G30)	Coronary heart disease (I20–I25)	Cerebrovascular disease (I60–I69)	Chronic obstructive pulmonary disease (J40–J44)	Hypertensive disease (I10–I15)
Rheumatoid arthritis	Coronary heart disease (I20–I25)	Dementia and Alzheimer disease (F01, F03, G30)	Cerebrovascular disease (I60–I69)	Chronic obstructive pulmonary disease (J40–J44)	Lung cancer (C33, C34)
Lupus and other systemic connective tissue disorders	Coronary heart disease (I20–I25)	Cerebrovascular disease (I60–I69)	Dementia and Alzheimer disease (F01, F03, G30)	Lung cancer (C33, C34)	Diabetes (E10–E14)

(a) Refers to the total number of deaths where one or more musculoskeletal conditions were listed as an associated cause of death.

Source: AIHW National Mortality Database (Table S5).

Conclusion

Musculoskeletal conditions are responsible for a substantial proportion of the non-fatal burden of disease in Australia (AIHW 2016). The primary purpose of this bulletin is to describe the contribution that musculoskeletal conditions make to mortality. Although musculoskeletal conditions were not among the leading underlying causes of death, this report shows these conditions were likely to have contributed to about 1 in 20 deaths in Australia in 2013.

Musculoskeletal conditions were directly responsible (as underlying causes) for 1,181 deaths in 2013 and contributed (as associated causes of death) to 5,782 deaths. The musculoskeletal condition making the greatest overall contribution to mortality was osteoporosis (1,856 deaths): osteoporosis was reported as an underlying cause of death in 167 deaths and as an associated cause in 1,689 deaths.

Limitations and next steps

This analysis examined the causes of death as reported by the certifying doctor or coroner on the death certificate, which is then coded by the ABS. The underlying data relies upon the certifier knowing all possible conditions that led to the death. In some cases, especially those occurring outside of a hospital or medical facility, it may be impossible to determine the contribution of any co-existing musculoskeletal conditions to the death. Therefore, as with other causes of death, this analysis may not provide a complete picture.

It may be possible to explore deaths involving musculoskeletal conditions that occur in a hospital setting. Future research, using linked data from the National Death Index and National Hospital Morbidity Database, could investigate the causes of death for people who had previously been admitted to hospital with musculoskeletal conditions, to provide further insights into the contribution of musculoskeletal conditions to mortality.

Appendix A

AIHW National Mortality Database

Data presented here are sourced from the AIHW National Mortality Database.

Cause of Death Unit Record File data are provided to the AIHW by the registries of births, deaths and marriages and the National Coronial Information System (managed by the Victorian Department of Justice) and include the cause of death coded by the Australian Bureau of Statistics (ABS). The data are maintained by the AIHW in the National Mortality Database.

'Year' refers to year of registration of death. Deaths registered in 2011 and earlier are based on the final version of cause of death data; deaths registered in 2012 and 2013 are based on revised and preliminary versions, respectively, and are subject to further revision by the ABS.

Cause of death information is sourced from death certificates, which are certified by either a doctor or a coroner. Causes of death are classified according to the *International Classification of Diseases and Related Health Problems* (ICD), which is revised periodically. Deaths registered in 1997 onwards are classified according to the 10th revision (ICD-10).

Cause of death coding produces an *underlying cause*—that is, the disease or injury that initiated the train of events leading directly to death, or the circumstances of the accident or violence that produced the fatal injury.

Most deaths also have *associated causes*—that is, all causes listed on the death certificate, other than the underlying cause of death. They include the immediate cause, any intervening causes, and conditions which contributed to the death but were not related to the disease or condition causing the death.

The data quality statements underpinning the AIHW National Mortality Database can be found in the following ABS publications:

- ABS quality declaration summary for *Deaths, Australia* (ABS cat. no. 3302.0), at <<http://www.abs.gov.au/ausstats/abs%40.nsf/mf/3302.0/>>
- ABS quality declaration summary for *Causes of death, Australia* (ABS cat. no. 3303.0), at <<http://www.abs.gov.au/ausstats/abs%40.nsf/mf/3303.0/>>.

For more information on the AIHW National Mortality Database see *Deaths data at AIHW*, at <<http://www.aihw.gov.au/deaths/aihw-deaths-data/>>.

Disease classifications

Musculoskeletal conditions

Causes of death presented in this bulletin are classified according to the ICD-10. The codes used to classify musculoskeletal conditions, as both underlying and associated causes, are presented in Table A1. Death records where a musculoskeletal condition was listed as the underlying cause of death can also have a musculoskeletal condition listed as an associated cause of death.

Table A1: ICD-10 codes for musculoskeletal conditions

Cause of death	ICD-10 codes
All musculoskeletal conditions	M00–M99
Rheumatoid arthritis	M05–M06
Gout and other inflammatory arthropathies	M07–M14
Osteoarthritis	M15–M19
Lupus and other systemic connective tissue disorders	M30–M36
Back problems	M40–M54, M99
Osteoporosis	M80–M82
Other musculoskeletal conditions	M00–M03, M20–M25, M60–M79, M83–M96

Leading causes of death

Leading causes of death presented in this bulletin are based on underlying causes of death and classified using an AIHW-modified version of the method described by Becker and others (2006).

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The mortality data in this bulletin were provided by the state and territory registries of births, deaths and marriages, by the Coroners and by the National Coronial Information System. These data are maintained at the AIHW in the National Mortality Database.

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Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
COPD	chronic obstructive pulmonary disease
ICD-10	International Statistical Classification of Diseases and Related Health Conditions, 10th revision
ICD-10-AM	International Statistical Classification of Diseases and Related Health Conditions, 10th revision, Australian Modification

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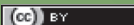
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